SCIENTIFIC AMERICAN

FEBRUARY 1926

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SCIENTIFIC AMERICAN

THE MAGAZINE OF TODAY AND TOMORROW

NEW YORK, FEBRUARY, 1926 EIGHTY-SECOND YEAR

FUTURES

THE recent announcement of the development of the Zworykin Thermionic Tube presents one of those opportunities to speculate on future development which is impossible to resist. A combination of the photoelectric cell and the radio vacuum tube, its sensitiveness is infinitely greater than anything yet developed. Variations of light falling on this tube instantly become variations by electrical current, amplified approximately one hundred thousand fold.

An alkali metal, such as potassium, is coated on the inside of the radio tube. When light falls thereon a shower of electrons is thrown off. Variations of the strength of the light vary the shower, infinite gradations being possible. This shower is tremendously amplified and produces a current sufficient to operate the ordinary relay, thus making it applicable for any purpose.

Peering into the future one can see limitless applications in commerce, war, astronomy, physics and in the more humanitarian aspect, the turning of printed words into musical sounds for the blind.

SLUMBER

IT is wrong in families where there are children to cease all noise when the babies are asleep. It is much better that the child should be prepared for the rough and tumble of later life by being allowed to sleep with noise going on everywhere. This is the advice Sir Harry E. Bruce-Porter, children's specialist, gives the National Society of Day Nurseries.

Dr. Bruce-Porter, let us ask you one question. Did you ever walk the floor at night, back and forth, back and forth, and finally get the baby to sleep? Then did you succeed in laying the baby down so gently and carefully that he still slept?

Then, Dr. Bruce-Porter, did you dare make a noise?

HOAX

THE great to-do in the newspapers about the discovery of lead crosses and other relics alleged to prove that a tribe of wandering Jews dwelt in the Southwest for a couple of centuries, long before Columbus made his famous trip beyond the edge of the world, seems to have been somewhat premature. The discovery appears to be a hoax.

The relics are said to bear dates such as "775 A.D." Now it happens that the use of the letters, "A.D." did not become general until long after the year 775. This reminds us of some bogus pre-Christian coins that were found bearing the date "445 B.C.," stamped into the metal!

In This Issue

MORE THAN 175 PICTURES

Complete table of contents will be found on page 144.

For Next Month

24,000,000,000,000,000,000,000 Cycles a Second
A new ray, with a frequency 1,000 times that of the X ray, has been discovered by Dr. R. A. Millikan, most noted American physicist, Nobel Prize winner. The newspapers have garbled the account. Get the truth from Dr. Millikan himself.

How Will You Mount Your Home-made Telescope?
There are several ways, ranging from simple to complex; and Mr. R. W. Porter, who contributes an epochal article to the present issue, will tell you, next month, how to do it.

Romance in Railroading
How many of the people of the United States have any knowledge of the Alaska Railroad? In our March issue we shall publish, by the courtesy of Secretary Work, a beautifully illustrated article by Noel W. Smith, general manager of the line, which will make you familiar with this great work.

Other articles on Poison Gas on the Farm; Greenland's Historic Mystery; The Subjugation of the Colorado; House Ventilating; Radio; Astronomy.

MORE THAN 175 PICTURES

PROGRESS

"LONG distance phone service between Egypt and Palestine is the latest modern device for the elimination of the long, weary distance over which Moses and Aaron led the children of Israel back to the Promised Land. Telephone conversations are now possible between the principal cities of the Holy Land—Jerusalem, Telaviv and Haifa—and Cairo, Alexandria and Port Said, in the land of the Pharaohs. The wires stretch across the Sinai Desert, which the Israelites traversed in their wanderings in the wilderness."

The surprising thing about this bit of news is not that telephone communication between these two centers in the Near East is now possible, but rather that for all these years it has *not* been possible. Suppose an American business man on a tour of the Orient last November had learned when in Cairo that an old chum was in Jerusalem; he would have attempted to reach him by long distance telephone. In nine cases out of ten he would have been amazed to learn that it could not be done.

It has been a long time coming, but at last the doom of the "Cedars of Lebanon" seems near; they may be cut into telephone poles.

BRIDGES

THE broad waters of the Hudson River are such a hindrance to the free transfer of freight and passengers between New York City and the rest of the United States that an ample provision of bridges of the first magnitude is obviously the only means by which this commercial separation can be overcome. The question of bridges versus tunnels, as a means of crossing the river, has been debated *ad nauseum;* and unfortunately most of this discussion has missed the great underlying fact that, for a given outlay of capital, you can secure from two to three times as much capacity from bridges as you can from tunnels. This fact has recently been urged by Samuel Rea, who recently retired from the presidency of the Pennsylvania Railroad Company. He can speak with authority on tunnels, since he was largely instrumental in building the first tunnels, those of the Pennsylvania Railroad, to reach New York from the west; yet only recently he stated: "I am still firmly convinced that no system of tunnels can ever do as much for the city as a bridge, properly located."

The building of the North River Bridge would provide the quickest relief to the present inadequate transportation facilities across the Hudson and would greatly assist in reducing port and harbor congestion.

Have We Food to Feed Our Immigrants?

By E. E. Free, Ph.D.

THE present immigration law of the United States attempts to do two things. First, it limits the total number of immigrants admitted in each year. Second, it selects those to be admitted from certain races and nationalities, to the exclusion, relatively at least, of other races and nationalities. These are the effects and intentions of the "quota" provisions.

These two chief intentions of our present policy are based, presumably, upon two ideas concerning the real facts about immigration. First is the idea that some selected races, peoples or nationalities are better material for our citizens than are people of other population groups. Second is the idea that we need no more people in the United States—or very few more—and that restricted immigration will leave more of the good things of life for those of us who are already here.

In the present article I propose to think aloud about the second idea that underlies our immigration law; the idea that limiting the stream of immigration will serve, somehow, to release us from the danger of overpopulation. This idea seems to have little real logic behind it.

We Must Be Informed

It must not be assumed, however, that the present immigration law is all bad. When we remember that the law was dictated, not by logic, but by passions, prejudices and political necessities, we can find words of praise for both law and lawmakers. It is quite possible, even, that the restriction of immigration is temporarily wise and that the selection by quotas is not so bad in practice as strict logic would compel us to decide. Questions of practical politics cannot always be decided as logically and scientifically as they will be, doubtless, when we attain Utopia.

So this article need not be taken as an attack on the present law or as a plea for its removal from the statutes. That is not the point at all.

What the point is, is this. We need facts. Some day we will have to draw a new immigration policy for the United States. It is one of the problems that must be settled and settled right, before the future of our country is in any degree secure. The present law may be right. If so, that circumstance is a happy accident. This law, however, is illogical. It is based upon ideas that are untrue. Let us attempt, while the present law provides some emergency protection, to reason out among ourselves some true principles of human migration; let us collect and examine what we do know. Let us see what more we need to know. No single authority can pretend to settle the immigration question for you. On the contrary. But it is not amiss to indicate some of the facts by which you can settle it for yourself.

The discussion of the immigration question involves what is probably the most serious problem of the world today; the problem of overpopulation. Are there, or are there not, too many people in the world? Are there—coming closer home—already too many people in the United States?

The answers to these questions depend mainly on the facts of food supply. It is obvious that there is still plenty of standing room on earth. There is ample room, even, for every man, woman and child to have a house. What fails is, as we say, a "good living" for everybody. This reduces, in the last analysis, to food.

Modern society has grown so complex, we earn our individual livings in so many different ways, that the real simplicity of the problem of keeping alive on earth has grown obscure. For example, to a man who sets down figures each day in a ledger and who receives for this labor a piece of paper which he exchanges for some small, tin cylinders in which he finds green peas or succotash, it seems unreasonable that his living depends on the wheat crop of Argentine, or, for that matter, on the corn crop of Iowa. Yet this is fact.

Brown Brothers

AT ELLIS ISLAND

A group of newly arrived immigrants waiting to be examined by United States Government officials

It may be love that makes the world go round but it is wheat and beef and succotash that keep us alive to watch it spin. If more immigrants can come into the United States, can find land to live on and can make this land, plus their labor, yield enough food to keep them happily alive, then by all means let those immigrants come. If, on the other hand, we are pressed, or likely to be pressed, by shortages of land or food, then let us take steps somehow to prevent any increases of our population, both the increase due to immigration and, if we can manage it, the increase due to the expansion of families that are already here.

This matter of the relation between population and food is so persistently misunderstood that it is worth while to try to make it clear by a much simplified model of society.

Population on an Imaginary Island

Suppose that there exists somewhere in the world an uninhabited but fertile island containing exactly one hundred thousand acres of agricultural soil. Suppose that two hundred people, men and women, land on this island. Suppose, further, that each family of a man and his wife can till to advantage exactly one hundred acres of land.

Let us ignore, for the moment, such excrescences of civilization as the banker, the policeman, the blacksmith or the thief. All of our islanders are supposed to be farmers. Each family of two will appropriate and farm its one hundred acres. This will absorb, usefully, ten thousand acres of land, or one-tenth of the island. Nine-tenths of the island will be left unused—and, for the moment unneeded.

But the population of our island will increase. On the average, there will be more than two children, so that when the parents have died there will be a net increase of the inhabitants. These new individuals will marry off, two by two, and will take up each pair its one hundred acres out of the nine-tenths of the island that remains unused. In time all of this remaining nine-tenths will be filled.

So far we have followed what some economists call the "pioneer" stage of a civilization. As popula-

tion increases, more and more land is brought under cultivation. Even if immigrants come to our island no trouble is created. There is still plenty of land. The immigrants simply go, two by two, and cultivate their hundred acres of the common patrimony. Essentially, that was the situation of the United States during at least the first century of its existence as a nation. Whether or not it is still the situation of the United States is the question which we are examining.

For simplicity let us continue to think of our island. The population has now increased—whether by births or by immigration is immaterial—until the island is full. Each pair of adults has its one hundred acres of land. What shall the islanders do about further increases of population?

It might be possible, you will say, to place more than a single pair of adults on each one-hundred-acre farm. Each family might arrange, for example, to employ a hired man and thus to produce more food from the same area of land.

To some extent this may be possible—it is occasionally and partially possible in real countries conducting real agriculture. But our islanders, like the real farmers, now run against what economists call the "law of diminishing returns."

The Ultimate Yield of Land

There is a certain amount of labor and a certain amount of land, which yield, in combination, the maximum proportional amount of food. We have assumed for our imaginary island that this maximum productivity is attained by the ratio of one family to each one hundred acres of land. If we add another adult laborer, or two additional adult laborers, or three laborers, and so on, we may get more food but we will not get *proportionately* more food.

Suppose, as a convenient unit, that each adult eats one bushel of corn a month. And suppose that the original two-adult family could raise on their hundred acre farm just four bushels of corn a month; that is, just enough for them to eat. Now we add another adult. His labor increases the yield of corn, let us say, to five bushels a month. He cannot add his full share of another two bushels, for we have assumed that the ratio of two adults to each farm means maximum productivity and the most favorable possible use of the land.

What has happened? By placing one too many persons on the land we have increased the corn consumption to six bushels, while increasing the production to only five bushels. Each person can have

Brown Brothers

IN FAR JAPAN

Where agriculture is very intensive. Here we see terraced tea plantations on the hills and rice fields in the valley

only one and two-thirds bushels to eat, instead of the full two bushels that is the normal diet. In the language of economics, we have forced a reduction in the "standard of living."

Now this parable of the overpopulated island applies exactly to the United States and to every country in the world. Do not be confused by the incidental complexities of the real world. On our island we assumed that every acre was alike and that every farmer was alike. In the real world these assumptions do not apply. Some farms are more productive than others; some farmers are more able than the average, and can make productive use of more land. But on the average these differences cancel out. The food—and happiness and prosperity—of men depend upon the sum total of food that they can wrest from the soil and from the sea, and upon the sum total of living humans between whom this food must be divided.

Do not be confused, either, by the extreme diversity of modern occupation. Not all of our citizens are farmers. How do they fit into the economic parable of our agricultural island? This, too, is simple. Suppose that the islanders hire a blacksmith. He lives somewhere on a tiny bit of land, only large enough for his house. He has no farm. He raises no food. What he does do is to forge plowshares for the island farmers. They pay him for these plowshares in food. Thus he gets his food. He lives without personal contact with the soil.

Why can the farmers afford to do this? Because the plowshares which the blacksmith makes for them help them to raise more food with the same amount of labor. They postpone the application of the "law of diminishing returns." Each family finds, let us imagine, that with the help of the blacksmith's plowshare they can raise four and a half bushels of corn each month instead of only four bushels. They can afford to give half of this increase to the blacksmith. Both of them will be ahead. The "prosperity" of the community is increased.

Have We Plenty of Land?

You can apply this for yourself to all the multitudinous "industrial"—that is non-agricultural—activities of a modern state. The banker, the policeman, the railway builder, the surgeon and all the others are worth their keep only when their work results, as does that of the maker of plowshares, in increasing the amount of food that one man can produce, on the average, from one acre of his country's land.

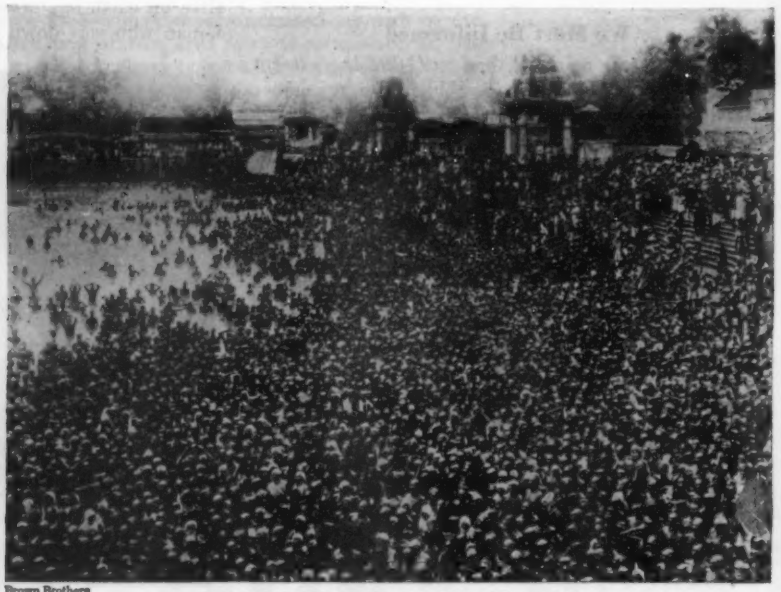
Now for the practical problem of the United States. Are we still in the pioneer stage, with more land available for an increased population? Or have we encountered already the point of "diminishing returns," after which any increase of population, from any cause whatsoever, must mean a lower average standard of living for our population.

The answer is a matter of opinion. On the face of the statistics there is plenty of land still available. The area of the continental United States is 3,036,789 square miles. Only about 1,500,000 square miles of this is recorded by the census as being "in farms." Even when one allows for the parts of the west which are used for stock raising or for other purposes, without being technically within the census figures, the statistics seem to indicate that not much over one-half of the area of the United States has been put to use in the production of food.

But statistics are tricky things. Of this supposed one half of our land inheritance that remains to us, very little is of any real value. Much of it is rocky and mountainous. Another large fraction is desert,

ON THE SIDEWALKS OF NEW YORK

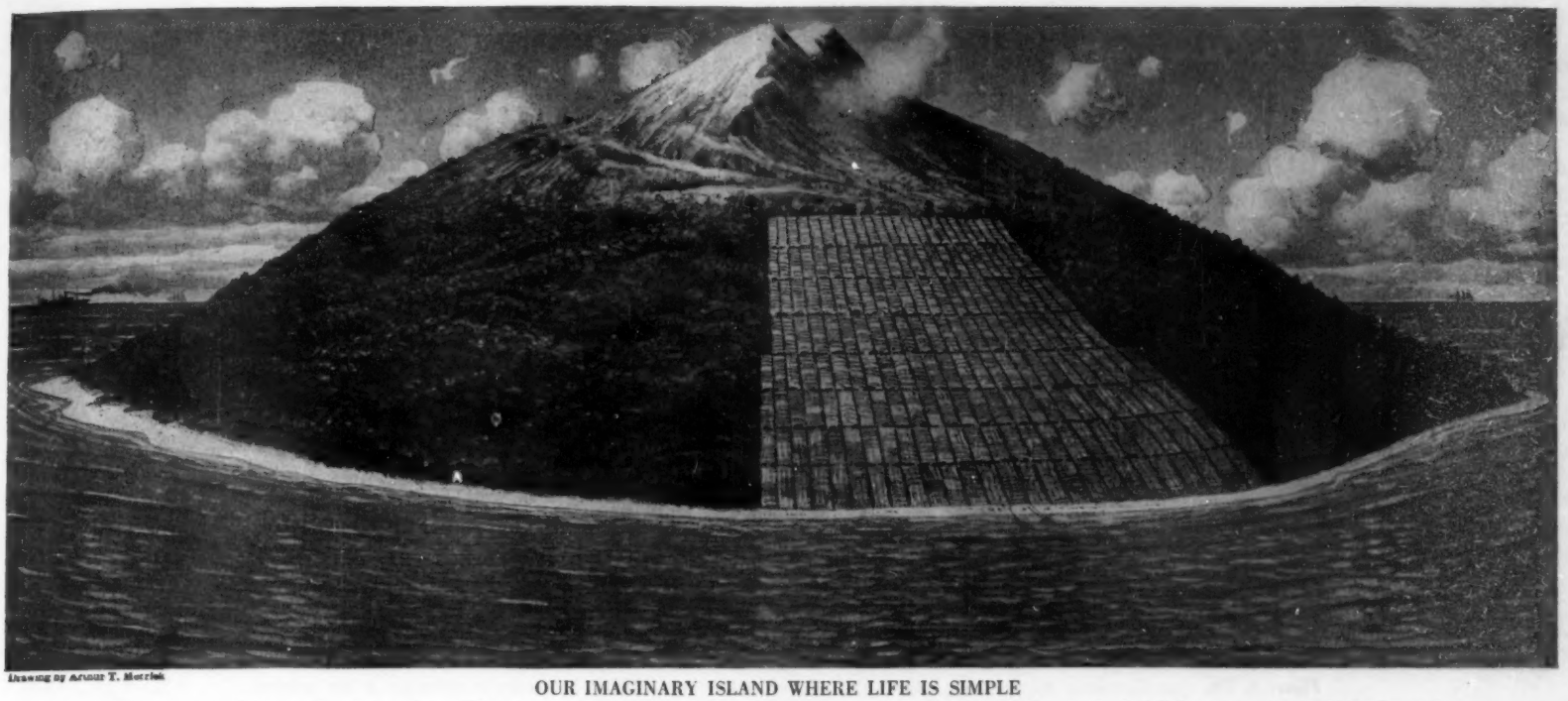
A typical scene in the streets of the East Side of New York, where a congested foreign population lives, or perhaps more properly, exists, and does business



Brown Brothers

A RELIGIOUS FESTIVAL DAY IN INDIA

India, too, is overpopulated. In this picture we see a multitude of Indian worshipers who have flocked to the Ganges to bathe and wash their sins away



Drawing by Arthur T. Merrick

OUR IMAGINARY ISLAND WHERE LIFE IS SIMPLE

Until overpopulation makes it complex. When too many people must be fed from too small a plot of land, the standard of living must necessarily be lowered

and the artificial reclamation of such desert lands is slow and expensive. Another part of our statistical resources consists of swamps and unreclaimable forests. Still other lands are infertile and it is useless to attempt to farm them.

It happens that I have had opportunity to observe agricultural conditions in every part of the United States. It is my opinion that our useful land is already exhausted. Our population is increasing by excess of births over deaths, to say nothing of immigration. Our land cannot increase. The fact of approaching overpopulation is a mere matter of arithmetic.

A word is necessary about two supposed ways of escaping this danger of overpopulation.

One is the policy already in practice in England. England does not produce enough food for her population. She makes manufactured articles instead. These she sells abroad, receiving in return enough food for her needs. The recent war was a sufficient exposure, I imagine, of the danger of this policy.

We Are Faced with Overpopulation

The second door sometimes suggested as an escape from the threat of too many citizens is the possibility of increasing the average productivity of the soil. The scientist who makes each ear of wheat yield an additional grain may defend us still longer. Agriculture remains capable of scientific improvement. But this will be, at its best, merely a postponement of the inevitable catastrophe. The flood of humanity rolls on. Nature's ancient reducing devices of war and pestilence we are attempting, with much success, to banish forever from the earth. We have lengthened the average life of Americans by eighteen years. We must pay for these successes in the coin of lessened food.

I do not see how anyone can escape the conclusion that we are faced, presently if not now, with a definite overpopulation of the United States. And I do not see how that can result otherwise than in an average reduction of the standard of living. Possibly this reduction will be spread more or less evenly over all our citizens. Perhaps, on the other hand, we will develop a stratification of society; a peasant class marked off distinctly from the classes of the well-to-do.

In either case, a reduction we must have, unless science takes some utterly new step like making food out of the air or contriving stomachs that do not have to be filled at all. Such things, I suppose, are possible; but they are too fantastic at present, for the realm of practical politics.

If this be true, you may conclude that it supplies an argument for the drastic restriction of immigration. The United States has too many citizens now. Why let in any more at all?

I do not look at it so. The problem of overpopulation is not created by immigration. If there had been not one immigrant admitted to the United States in the last ten years we would still be faced with an approaching lack of food. The really important sources of population pressure are the excess of births over deaths and, more important still, the lengthening of the average length of life by modern efficient methods of disease prevention and bodily repair.

Brown Brothers

THE INTELLIGENCE TEST

To insure a higher type of future citizens, we need a strict application of intelligence tests to our immigrants

There is only one real cure. That is some way of limiting births. But the present propaganda for birth control has not yet received the sanction of the scientic professions, let alone of the sociologists or the clergy.

With regard to immigration, any attempt at restricting of the total of admitted immigrants is but a palliative. Such an attempt would be about as ineffective as pouring a bucket of water on a burning forest.

But there is one thing that a wise immigration policy might do. It might help us to increase the average competence of our population. There are too many Americans, both native-born and immigrant, who are quite definitely and demonstrably no good. They are not helping to produce their share of the food.

We Need Better Americans

This improvement ought to begin at home. The worst immigrants that anybody could be induced to admit would compare quite favorably with considerable elements of our present population.

But self-improvement is perhaps impossible just now. So let us use the immigrants as one way to improve ourselves. Let us admit no immigrant who is not actually and demonstrably *better* than the average American. To admit that it is possible for him to be better may hurt our pride, but pride butters no parsnips.

The next question is how? Is it possible to contrive an immigration policy that will select immigrants who are potentially better than the average American; who will probably be able to increase the average productivity of our agricultural population? Possibly so; possibly not. Suggestions along this line are future possibilities. They will not involve any criteria of race.

Whether this be possible or not, it is at least something to know what we are trying to do. We ought not to try merely to limit the total amount of immigration. That will do no good unless we also limit ourselves. What we ought to try for is new citizens who will raise the food-producing average of this economic island that we call the United States.

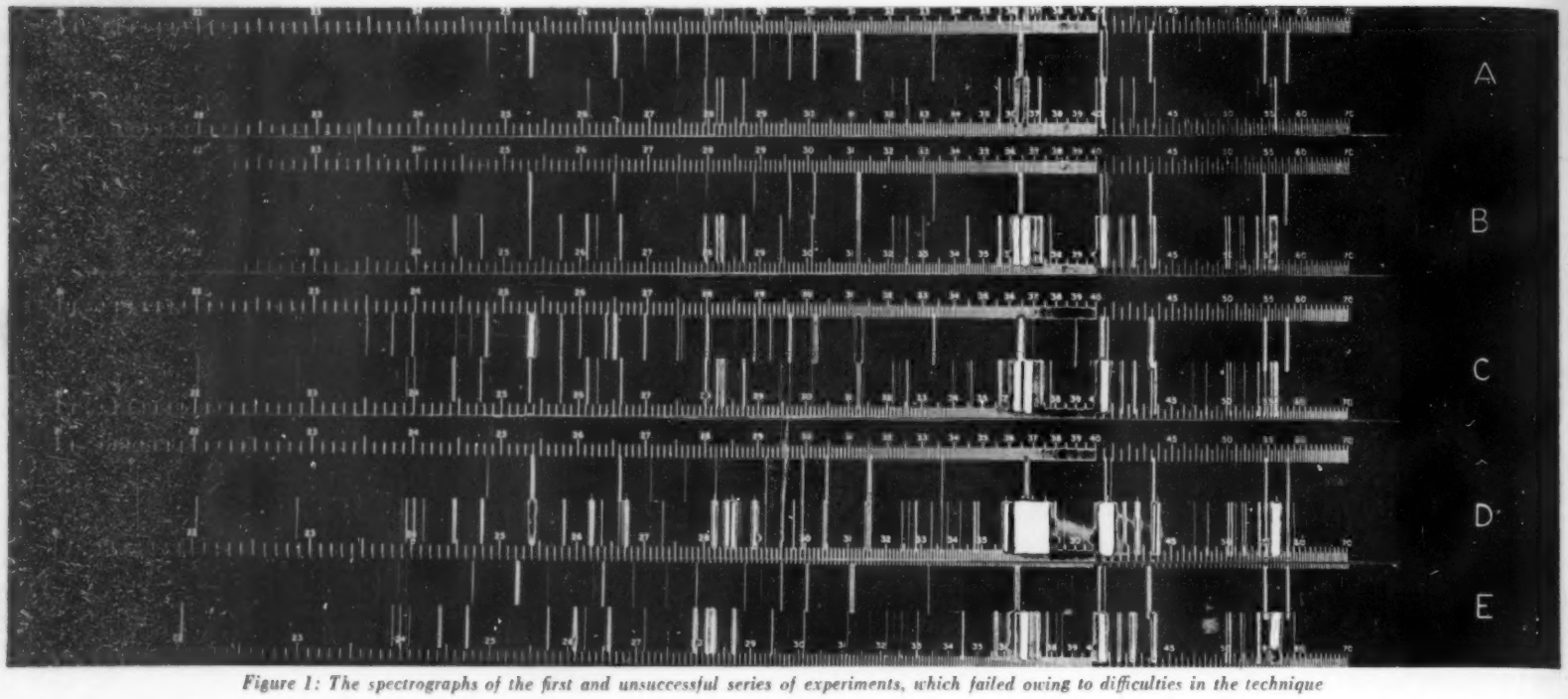


Figure 1: The spectrographs of the first and unsuccessful series of experiments, which failed owing to difficulties in the technique

The Transmutation of Elements

Using the Quartz Mercury Vapor Lamp, Two Dutch Scientists Claim to Have Changed Lead into Mercury and Thallium

By Professor Doctor A. Smits and Doctor A. Karssen
Laboratory of General and Inorganic Chemistry, University of Amsterdam, the Netherlands

IN our first paper, published in the October, 1925, issue of the Scientific American, we gave a brief description of the experiments which we are carrying out in order to determine whether lead can be transmuted into another element. As our experiments are now far enough advanced for publication, some of the results will be communicated here.

Two series of experiments were made, the first of which, owing to certain complications, was indecisive. The second series, however, resulted in the transmutation of the element, lead, into mercury and thallium.

Since in our experiments we were investigating the possibility of transmutation into mercury, it was necessary from the first to avoid the use of a mercury air pump and a mercury manometer. Therefore, the lamp employed was evacuated by a carefully cleaned, metallic pump, connected with two V-tubes placed in liquid air; and finally by a large vessel, filled with coconut carbon. It was also cooled in liquid air, a method by which a high vacuum could be obtained.

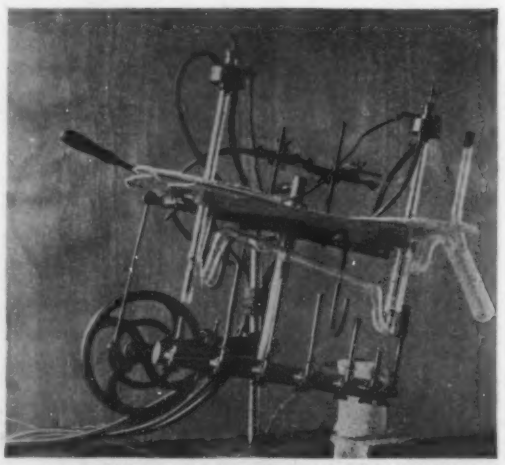
Efforts to Obtain Pure Lead

When not working in a vacuum, the pressure was measured by a glass-spring manometer provided with a calibrated scale; working under pressure, the connection with the coconut-vessel was broken, and purest nitrogen was let in.

It is obvious that in such a piece of research as the present the materials used must be as pure as possible. At first, then, the experiments were carried out with "pure" lead supplied by Kahlbaum; later, in order to forestall every form of contamination, especially that by mercury vapor, this firm was so kind as to prepare for us with the utmost care, new "extra pure" preparations. Following out our wishes, when it became necessary for Kahlbaum to use a high vacuum in the purification of this mercury, high vacuum pumps which operated without mercury were employed by them, just as by ourselves, and it is a fact that in their new lead preparation marked "extra pure," neither mercury nor thallium could be found analytically.

In addition to these necessary precautions the quartz parts of the lead lamp were cleaned with a solution of potassium bichromate and nitric acid, steamed and finally were heated in a current of hot air until they were red hot. Likewise, the metallic steel parts of the lamp were cleaned and heated to redness; while the carbon valve suffered quite the same operation.

The procedure in the investigation was now as follows: After filling the lamp with lead, the latter was heated in a high vacuum until it was red hot. The lead oxide coating now being completely dissociated, the surface of the liquid lead became as brilliant as mercury.



PRODUCING MECHANICAL OSCILLATION

Figure 2: In order to circumvent the heating effects due to the use of direct, uninterrupted current, the circuit was broken at regular intervals by means of this device

The lamp was left to burn in vacuum at about 25 volts and about 36 amperes. The spectrum was now photographed by means of a Hilger quartz-spectrograph. At the same time the spectrum of a mercury lamp was photographed with the scale superimposed, in order to facilitate the comparison of the different spectra. (See Figure 4, Ao.)

We burned our lamp in a vacuum as well as under pressure up to .5 atmosphere. In the latter case the voltage was increased to 120 volts, but in every case the spectra were always photographed under exactly the same conditions—that is, in vacuum, at about 25 volts and about 36 amperes.

The first experiments were indecisive, but important.*

The First Attempts Were Failures

In our first experiment the lamp was burned at 36 amperes and 80 volts, with the result that while at first the lead spectrum showed only the mercury line 2536 Angstrom units, after six hours burning the strongest mercury lines in the visible as well as in the ultra-violet part of the spectrum had distinctly appeared.

Further experiments made by using various voltages and currents indicated clearly that it was current density rather than voltage which influenced the results, and that the first voltage and amperage used were very favorable. It was also of interest that even though running the lamp for many hours at low amperage, no lines appeared, thus justifying our methods of keeping the lead free from contamination.

Returning to the initial voltage and amperage (25 amperes, 80 volts) a positive result was again ob-

*EDITOR'S NOTE: Owing to limitations of space, it was necessary to shorten the account of the first and unsuccessful series of transmutation experiments. The next nine paragraphs, therefore, are an abstract of the original paper.

tained. After ten hours the strongest characteristic lines of mercury and also of thallium were obtained, both in the visible and ultra-violet parts of the spectrum.

This indicates a transmutation of lead into thallium and mercury.

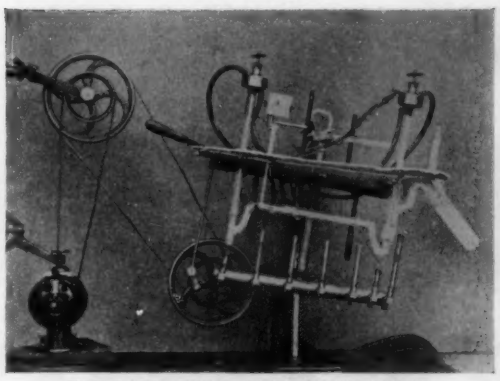
In accordance with our experience that high current densities were necessary, we next experimented with currents up to 50 amperes, but only by intensive air cooling could melting of the quartz lamp be prevented. On this account we thought it better to alter our method a little, applying not direct or uninterrupted current, but sparks of high current density.

We therefore constructed an apparatus as shown in Figure 2, which could be oscillated mechanically in such a manner as to obtain sparks of high current density. On making contact the current was about 100 amperes, and on breaking it was considerably higher.

After sparking, a black film appeared on the lamp, which was removed by continuous running for some hours, after which the photographs were taken. In Figure 1 are shown a number of spectra taken in this manner. In each case the spectrum of mercury is shown for comparison, and below it the spectrum of the material in the lamp. Going down the figure are photographs taken after increasing time of sparking.

The Attempt That Did Not Fail

If we study the lines carefully it will be seen that the only line in the spectrum of our lamp's contents corresponding to a mercury line at the beginning of our series (Figure 1, A) is the line 2536. Other lines appear in the later photographs, and finally all the mercury lines appear. Of course, many which are to be seen on the plate are lost in reproduction. (The line 2802 is a lead line near the mercury line 2804.) It should be noticed, however, that as we go down the series, the mercury lines increase in brightness, then decrease later as shown in Figure 1, E, which was taken later than Figure 1, D (Use 2536 for example). This we believe to be due to the deposits which appear on the lamp. These consist of lead silicate, silicon, and later, thallium silicate is added. The evaporation of these substances



THE LAMP THAT TRANSMUTED LEAD

Figure 3: Showing, near the top, the extra, vertical tube surmounted by a nickel mirror. This arrangement made it possible to study the transmutation with the spectroscope

from the wall, when hot, results in a high vapor density near the walls and an increased radiation of the lead lines and of the thallium lines. As the mercury does not play any part in this it can only result in a weakening of the mercury lines by absorption.

This, however, is a minor point, the interesting thing being that mercury lines appear at all.

In order to render ourselves independent of the film formation, we once more altered our lead lamp and this time, we were successful in our attempt to transmute lead into mercury and thallium.

At the place where the arc is formed, although the temperature of the lamp is never very high, a quartz tube of fifteen centimeters length and eight centimeters inner diameter was sealed in, the upper end having been provided with a flat top.

The light of the arc, passing through the unattacked quartz top and then reflected by a nickel mirror, was directed at the quartz spectrograph as shown in Figure 3. The transmutation could now be studied as long as the lamp stood up.

We now started again with "extra pure" lead from Kahlbaum's, marked "L," and this in a lamp which again showed a mercury-free spectrum.

To provide a good criterion, in Ao, Figure 4, the real, initial spectrum of the "extra pure" lead is given. It must be mentioned here, that the light of the quartz mercury lamp is not reflected by a nickel mirror but only the light of the quartz lead lamp; here the light in the ultra-violet part of the spectrum is weakened a little.

After five hours of sparking (or, in total, eight and three-quarter hours) we obtained with an exposure of fifteen minutes photograph shown at B, Figure 4.

This shows that along the whole lead spectrum the mercury lines are dominant!

After five hours, twenty-five minutes of sparking (or in all, fourteen hours, ten minutes) we obtained, after a ten-minute exposure, photograph C, Figure 4. It shows how strongly dominant are the mercury lines in the lead spectrum. The lead lines are considerably weakened and the mercury lines are very strong.

The striking result just given seems to justify the expectation that if the lamp had a long enough duration of life, the point could be reached where the lead spectrum would have disappeared completely.

Even this would not, however, prove that the transmutation was exceedingly strong, for as is well known, a relatively small amount of mercury can cause the spectrum of another element to disappear.

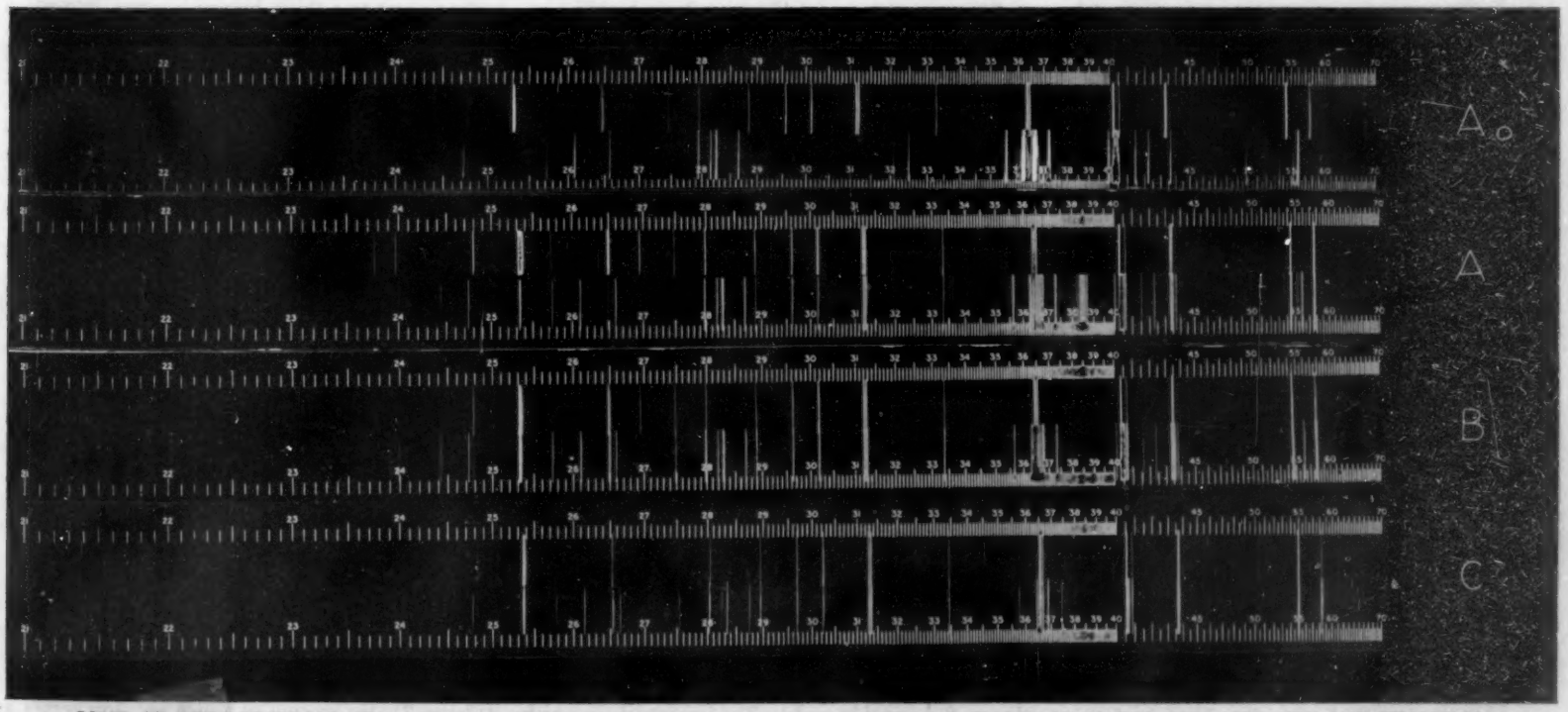
A Demonstrated Transmutation

This last series of experiments have demonstrated to us in a convincing manner the transmutation of lead into mercury. Further, it again proves that our inferences as to the reason why the mercury lines faded out, whereas the lead lines faded out with continued sparking, are correct.

The reason why the lead lines become stronger must lie in the influence of a strongly heated film in the quartz tube. Consequently Figures 1 and 4 agree completely.

It is interesting to observe, that while applying the first method of observation, some thallium lines appear distinctly; these lines are weak or are not perceptible at all in the second method. The explanation of this fact is probably that, like lead, thallium is taken up by the quartz wall.

In the next paper we will communicate the results of our quantitative determinations and give some theoretical considerations of the transmutation found. (Amsterdam, November, 1915.)



SOME OF THE SPECTROGRAPHS OBTAINED FROM THE SECOND SERIES, IN WHICH LEAD WAS TRANSMUTED INTO MERCURY AND THALLIUM

Figure 4: These spectra, beginning with the comparison spectrum (mercury) Ao, at the top, form a series. As the sparking progresses, the mercury lines in the lead spectrum became stronger and stronger, while the lead lines weakened; if the lamp had endured long enough, the lead spectrum probably would have wholly disappeared

Dr. MacDougal and (on the left) Dr. Clarke, the author, trying to duplicate the elusive life process with the artificial cell

What Is Life?

The Puzzling Phenomenon Called "Life" Is Being Studied by Means of a Working Model of a Living Plant Cell

By Beverly L. Clarke

WE are so far from a perfect understanding of life that even active workers in biological research cannot agree as to the real nature of life—whether it is purely a matter of chemistry and physics and evolution and chance, or whether there will indeed prove to be an element of the nature of the "spark of life" of the ancients, transcending mortal understanding.

Of great interest in this connection are some recent experiments by a distinguished American physiologist, Dr. D. T. MacDougal, Director of the Carnegie Institution of Washington's Laboratories for Plant Physiology at Tucson, Arizona, and Carmel, California.

For many years Dr. MacDougal has been studying the phenomenon of life by a very rational method. He has chosen as his materials chemical substances of the same nature as those occurring in living matter, and has subjected them, singly and in combinations, to the various conditions to which living material itself is normally exposed. He has made elaborate studies of the action on these materials of certain physical processes believed to play important roles in life.

Such a process is that known as swelling, wherein certain semi-solid substances like gelatin, when immersed in water, will attract to themselves molecules of water which they hold with great force, with consequent increase in size. There is no doubt that swelling is an intimate associate of most life processes. Someone has suggested that the mechanism of muscle action is simply a matter of swelling and shrinkage of the muscle fibres. Dr. MacDougal has invented an instrument (shown on page 83) for making an automatic record of the swelling in liquids of gelatin plates or of sections cut from the living cactus plant.

It is now generally known that the unit of living matter is the cell. The cell is the building-stone—the brick—from which all plants and animals are constructed. Life may indeed be regarded as the resultant action of the cells of which the organism is composed. What more natural, then, than to concentrate attention on the single cell? There is little doubt that these microscopic objects hold the key to the full understanding of life.

Dr. MacDougal has made a deep study of the known facts about cells. He has dealt particularly with plant cells, but that does not destroy the general character of his results. Viewed as a piece of architecture—as one would view a large building or the ground-plan of a town—the cell is a fairly simple affair. Figure 1 gives a general idea of the plant cell. It develops from a tiny mass of jelly, and the first change is perhaps a matter of self-protection—the outer layer of this ball of jelly undergoes a hardening process which forms it into a tough protecting sheath.

Most Primitive Plants Are Single Cells

As the cell enlarges, first by the addition of more material and then by absorption of water, the central portion becomes a hollow, water-filled cavity and the jelly-like protoplasm is pushed towards the outer wall to form the soft, semi-solid layer we call the plasma, or plasmatic layer. If now we place in the plasmatic layer a number of dark-colored bodies, the picture is complete. The simplest plants and animals—the ancestors of us all—consist of only one cell which under the microscope looks very much like this.

The natural sequel to Dr. MacDougal's series of researches on the chemistry of protoplasm was an attempt to construct a model of the living cell, of similar materials arranged in similar relations to each other as in the actual cell.

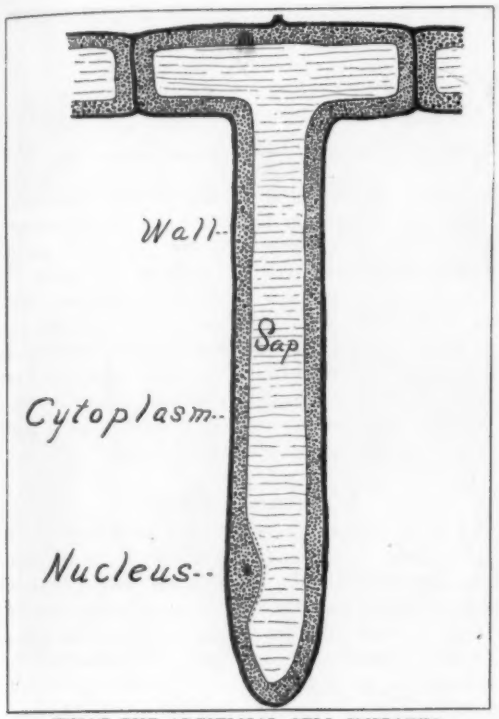
Much experimentation was necessary before the present model of the "artificial cell" was designed. Figure 2 shows this model. The framework on which the cell is built is a paper thimble about one inch in diameter and three inches high. This thimble, being pure cellulose, also serves admirably as the external cell-wall.

The first step in the limitation of the plant cell is the deposition within the meshwork of which the cellulose thimble consists, of substances of sugar-like composition and jelly-like consistency. Such substances are agar-agar, which is extracted from a kind of sea-weed and comes in crisp flakes like breakfast food, and pectin, a similar material found abundantly in apples. These substances are dissolved in boiling water to a thick, brownish syrup, into which the thimble is dipped. In order to obtain the desired physical structure, the thimble is now treated with alcohol, which abstracts part of the water. Next is prepared a solution of a mixture of gelatin and agar in proper proportions. To this is added a small quantity of some fat, a little soap, and a minute trace of salt. All these are included to represent actual conditions in plant protoplasm, which contains a very small amount of a great many substances. A layer of this hot mixture, a quarter of an inch thick, is applied to the inner surface of the thimble and allowed to harden, representing the plasmatic layer.

A rubber stopper carrying glass tubes is inserted in the thimble, and a solution of sugar is poured in to represent the cell sap. The "artificial cell" is now ready for operation.

What will it do? In general, it may be answered that this artificial cell will do a great many things that its living model does. If the cell, constructed as described and filled with sugar solution, is placed in a glass beaker containing either pure water or a solution of some salt, water alone or water plus particles of salt will pass through the cell wall and into the solution of sugar. If the cell was originally full of sugar solution, any further liquid passing into it will cause an overflow through the tube B (Figure 2), the amount of which overflow serves as a measure of the activity of the cell.

In the case of the living cell, much is known about



WHAT THE ARTIFICIAL CELL IMITATES

Figure 1: Schematic diagram of a root hair, the cell which protrudes from plant roots and absorbs plant food

its conduct in various salt solutions, what salts are allowed to enter and which kept out, and the speed at which each will act. Most of these facts have little rhyme or reason to them; that is, they do not seem to be explainable by the known laws of chemistry and physics. Thus, when the solution in which the cell is immersed contains certain pairs of salts, there is often a curious effect spoken of as antagonism, whereby the penetration of each salt is modified greatly by the presence of the other. This phenomenon of antagonism has been thought characteristic of protoplasm, and there is no known property of the constituents of the protoplasm or of the salts which accounts for it.

In many such cases, Dr. MacDougal's artificial cell has proved itself to be a faithful reproduction of the living cell. To the chemist this is a very striking thing, for it contains the insistent suggestion that this business of interference of ions, long a mystery, will ultimately prove to have a simple explanation in terms of chemistry and physics.

One specific case of this general sort, where the artificial cell imitates nature in an astonishing manner, is that concerning the absorption by plant cells of the two common elements, sodium and potassium. These two elements, in their various compounds, are among the most abundant substances in the world. From the chemical standpoint they are remarkable in the close similarity of all their characteristics. That means, in terms of the new science of atomic structure, that the atoms of these two metals have architectures as nearly alike as two floors of a skyscraper.

Sodium and potassium are, as would be expected, practically interchangeable in most experimental processes in which they take part. One long-known and striking instance where they are quite different, however, is in their penetration into plant cells. Whereas theory would suggest that they would be about equally absorbed, experiment shows that, under comparable conditions, *sixty times* as much potassium as sodium is taken up and held by the cell. This goes absolutely against all chemical theory. About all we know about it is the repeated demonstration that it is so. It has been often pointed to as a "property of life," or as due to the "selective action" of the cell, indicating that living processes are governed by laws entirely different from those holding in the realm of inanimate matter.

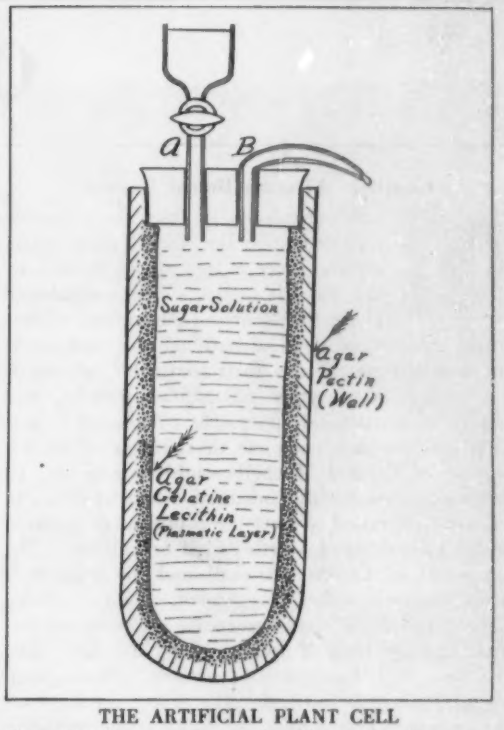
Artificial Cell a Practical Tool

Now comes the artificial cell, made in the laboratory, from materials as dead as a defeated presidential candidate, and having to the living cell only an approximate chemical similarity. On subjecting his cell to appropriate experiments, Dr. MacDougal discovered that about five times as much potassium as sodium was absorbed. At first glance, one might be inclined to say that, after all, there's a big difference between sixty times and five times. Quite true, but the point is that chemistry finds itself at just as much of a loss to explain the five times as it does the sixty times. Biologists who have worked with the artificial cell are convinced that once the true explanation is found for the five-fold deviation from the theory in this case, the same explanation will hold for the living cell.

No claim is made that observation in the artificial cell of processes previously thought peculiar to living matter, constitutes directly an explanation of these processes. In no sense is this so. The importance of the artificial cell is as a tool which is infinitely easier to handle and work with than the minute living cell.

In our artificial cell, the chief initial difficulty is in the establishment of such a similarity between the actual living cell and its man-made model. The author of the artificial cell makes no claim to perfect similarity. He knows quite well that his model is only a first short step. But he believes, and his evidence is convincing, that his artificial cell is so like the real cell that it will duplicate in principle certain actions which are very important for the understanding of life.

Our artificial cell will for a very short time take up food material and water, with coincident increase in size. In other words it will *grow*. But unlike the real cell, it ceases to grow after a short time. To make it grow further, we must "wind it up" again, which means we must substitute new solutions for the spent ones. Then growth proceeds for another short period, and again stops. It has been demonstrated that, in this case, the cessation of growth is due to the cell system having reached what the chemist calls a point of equilibrium. That is, a state of balance has been produced.



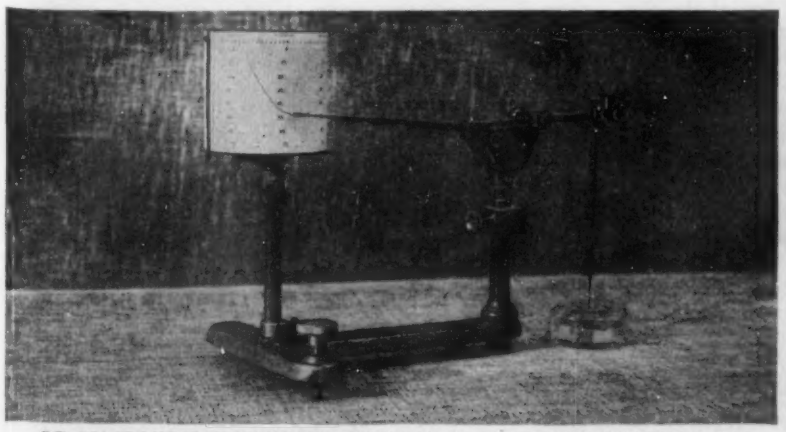
THE ARTIFICIAL PLANT CELL

Figure 2: This is not the actual artificial cell as it appears in the laboratory, but a schematic diagram

The process of cell action seems to be essentially a series of chemical reactions. These are going on at different rates and in different directions. This being so, it is inevitable that sooner or later everything must come to a standstill.

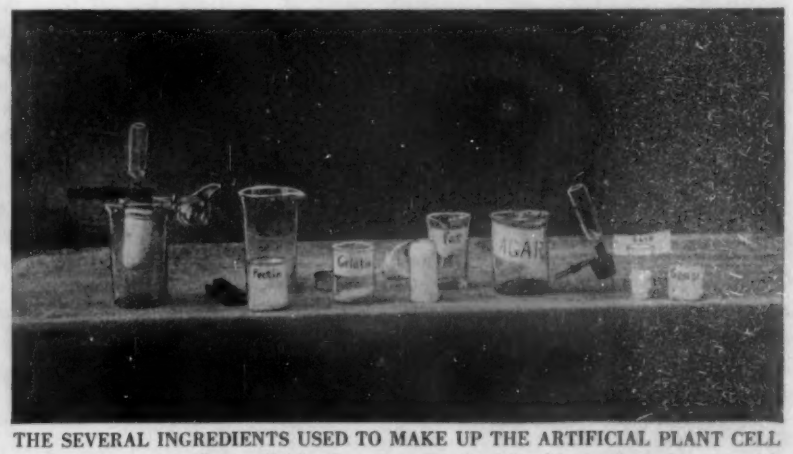
The chief difference between the artificial cell and the living cell seems at present to be that in the former the intervention of man is necessary to "throw the switch"—that is, to upset the balance and start things going again—while the living cell is apparently provided with some unknown mechanism for doing this at the psychological moment.

It may be, indeed, that the really unique thing that characterizes a living cell as different from its man-made counterpart, is this mysterious device for pulling the trigger just at the right time.



DR. MACDOUGAL'S "AUXOGRAPH" RECORDS THE SWELLING OF PLANTS

Three sections of living plants are placed in the dish. As they swell, the vertical rod which bears on them actuates the lever and the clock-driven recorder, which gives a permanent record of the amount and time of growth



THE SEVERAL INGREDIENTS USED TO MAKE UP THE ARTIFICIAL PLANT CELL

At the left is the complete artificial cell, set up. On the right of it are the various materials which make up its physical structure. The glassware device shown near the extreme right is a part of the artificial cell shown at left

Our Point of View

Coolidge Aircraft Board Report

OF the various Boards that have already reported upon the subject of aviation, the first place in importance is taken by the Aircraft Board, which was selected by the President and is composed of nine men, military and civil, of national note and carrying a high reputation in their particular spheres of activity. The report is unanimous, judicial, and devoid of sensational statements. Although it recommends no such complete overhauling of the air service as Colonel Mitchell would like to see, its suggestions are highly constructive and, it seems to us, are well suited to meet the problems of aviation in the United States, whether civil or military. The proposals of Colonel Mitchell and his supporters are stated to be either exaggerated, or without foundation, and the proposal to create a unified air service, and the plan of amalgamating the Army and the Navy in a department of national defense, with an air branch, is rejected. The report recommends the creation of an additional assistant secretaryship dealing with their respective aircraft activities, in the Departments of War, Navy and Commerce. It believes that this would result in a better solution of aircraft problems and open the way for a more satisfactory advancement for Army and Navy fliers.

The Board believes that, because we are so well protected geographically, a large air force is not necessary to the defense of the territory of the United States, but that the development of the use of civilian aircraft should be encouraged by creating a bureau of air navigation in the Department of Commerce under an additional assistant secretary. The fear of attack by a potential enemy of menacing strength is stated to be unreasonable. The strength of the air army in proportion to the general military establishment compares favorably, we are told, with that of any other power. Our Army and Navy personnel is found to be of the very highest type.

The report commends itself to us as meeting the problems of the present air situation in a reasonable and thoroughly constructive manner. We are decidedly of the opinion that the best way to build up our air defense is to encourage civilian aviation by passing the long delayed laws which are so essential to its development.

In this connection, it is in place to refer to the verdict in the Mitchell court martial. Unlike the inquiry by the President's Board, this investigation had to do with discipline and conduct. He was found guilty of violating the Ninety-sixth Article of War. His criticisms of his superior officers amounted to insubordination, and his conduct was found to be prejudicial to military discipline. A strict rendering of the law would call for his dismissal; but because of his fine record in the war, he is merely suspended for a period of five years.

Fire Perils at Sea

THAT fire risk at sea is a fearful and ever-present peril has been shown by several recent disasters to coastwise freight-and-passenger ships. They prove that, though provision against foundering has made great strides; prevention of loss by fire, at least in these mixed freight-and-passenger ships, lags far behind. The Steamboat Inspection Service, although it calls for fire-detecting apparatus, does not go so far as it should in demanding adequate provision in the holds for immediately putting out a fire, once it has been discovered. Another, to us, astonishing fact is that the ship classification societies make no demand for adequate fire protection. Hence, we are not surprised that while losses through foundering are decreasing, those due to fire are relatively on the increase.

Now, for the protection of their ships and passengers, the owners of the large Atlantic liners have voluntarily equipped their vessels with a system which instantly notifies the bridge if a fire starts in a hold and, also instantly, smothers the fire by flooding the hold with live steam or other active retardant. The holds, it is needless to say, are so constructed as to be, if we may use the term, fire-tight.

The Sacrificial Pool of the Maya Indian Maidens

The picture on the opposite page shows the ghoulish cenote of sacrifice at Chichen Itza, the capital of the ancient Mayan empire. The cenote was venerated throughout Central America by the Mayas as the Holy of Holies. In its dark, deep pool, hundreds of young Indian maidens were sacrificed to the god of rain, says tradition.

That this unhappy tradition is true has now been proved by dredging in the deep mud at the bottom of the pool, from which innumerable bones of skeletons have been recovered.

The Castillo shown elsewhere in the picture was the principal temple, and from it the unfortunate maidens were led down the processional way with accompanying music, to the sacrifice.

Other features of the city of Chichen Itza are shown as they recently appeared when the thick brush with which the site was overrun had been partly cleared by Dr. Thomas Gann's recent expedition. Many of the buildings have yet to be uncovered.

The fire-prevention system that is installed on the "crack" liners includes means both for detecting a fire and for quickly putting it out. Each hold is an entirely separate structure, with bulkheads, decks, and overhead casing of steel, and capable of being entirely shut off from the rest of the ship. From the top of each hold a small smoke pipe leads to a cabinet on the bridge, where it vents to the air, means being provided to induce a slight exhaust suction. Individual steam pipes lead from the boiler room to the holds. Immediately, upon seeing smoke issuing from a tube, the officer on the bridge can turn steam into the corresponding hold, quickly extinguishing the fire. Another protection which should be applied to all passenger accommodation is the provision of steel fire-bulkheads, extending clear across the long row of staterooms, at stated intervals, and provided with fire-tight doors across the alleyways.

The classification rules of the insurance companies and the requirements of the Steamboat Inspection Service should be modified to make *all* passenger-carrying, ocean-going ships in coastal service provide both fire-detection and fire-extinction construction and apparatus, before they receive either insurance or the Steamboat Inspection Service sanctions.

The most elementary humanitarian considerations demand this; it was due to sheer good luck as to weather and location, coupled with the discipline of the crew and the self control of the passengers, that two shiploads of passengers were not wiped out by fire in the recent disasters. Had the ships been upon the transatlantic route and far from land, the fire which swept through the inflammable staterooms would have driven the passengers to the boats and left them at the mercy of wind and sea.

Is Science Callow?

WHAT science needs most today is a true vision rising above spectrometers, cell walls, vapor tensions, microtomes and polarities, and seeing beyond them—as far as man can hope to see—the end toward which all these humbler things are but little steps.

Such a vision is that of Professor Theodore D. A. Cockerell of the University of Colorado—biologist, zoologist, entomologist of note, but known, because of his writings, to all the biological world as "the Huxley of America"; a man who has made of a little corner of science a true philosophy, who has brought to those who care more for life itself than for a test-tube full of green precipitate, a foreshadow of what science, under better guidance than that of our day, might mean to the "man in the street."

Concerning the higher beliefs of the true scientist, Professor Cockerell says:

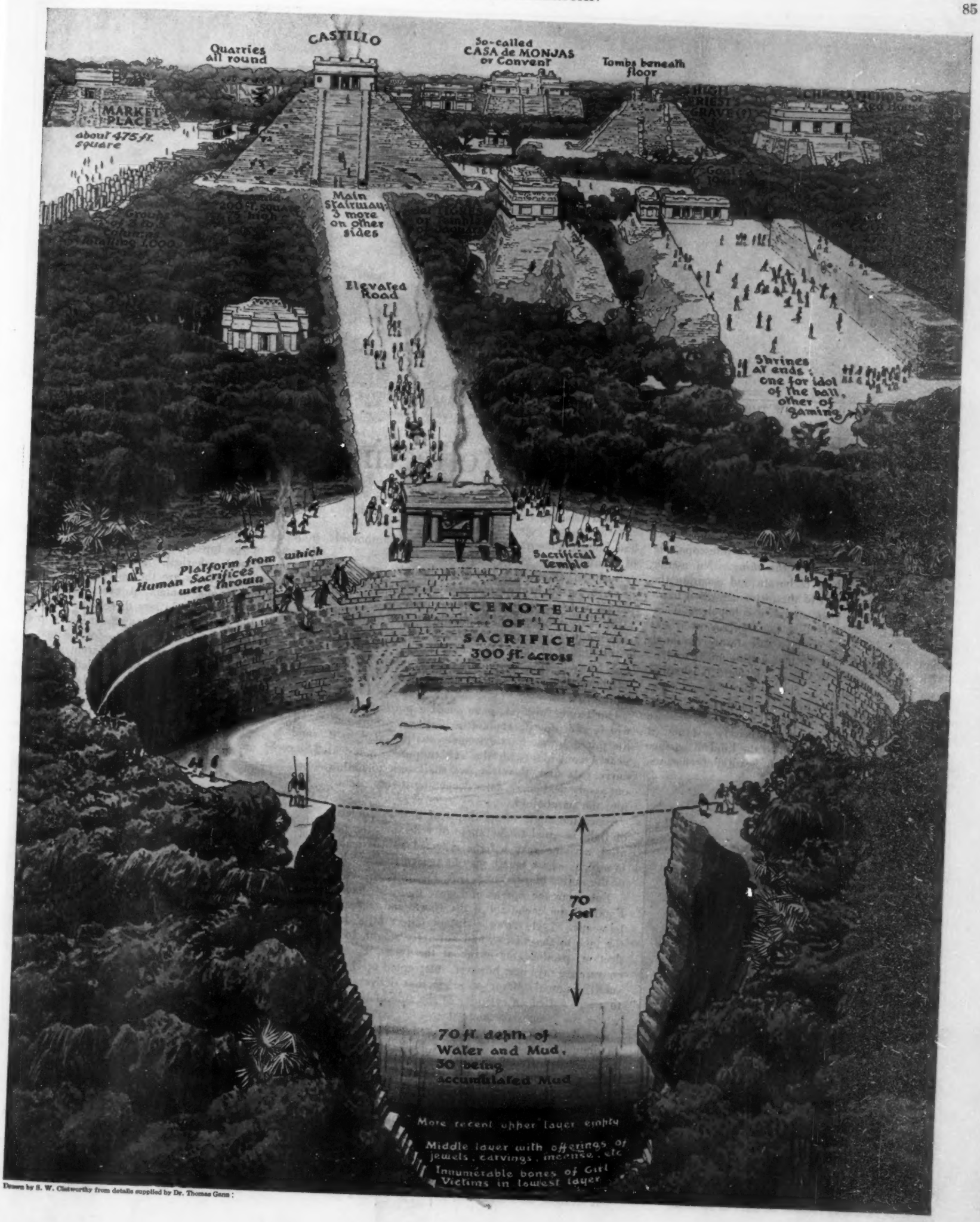
"The scientific man spends his life trying to discern the workings of the Law, in order that thought and deed may conform to Nature's harmony. The more he investigates, the more sure he becomes that order prevails, and that there are no supernatural phenomena, nor ever have been. But we must hasten to add that he knows full well that only part of Nature is or can be revealed to him, and that beyond what he knows as science, is a vast realm at present beyond the reach of experiment."

"This," continues Professor Cockerell, "is why Alfred R. Wallace, one of the greatest naturalists of modern times, wrote in his ninetieth year that the attempt to solve Nature's problems had given him, during his long life, an ever growing sense of mystery and awe."

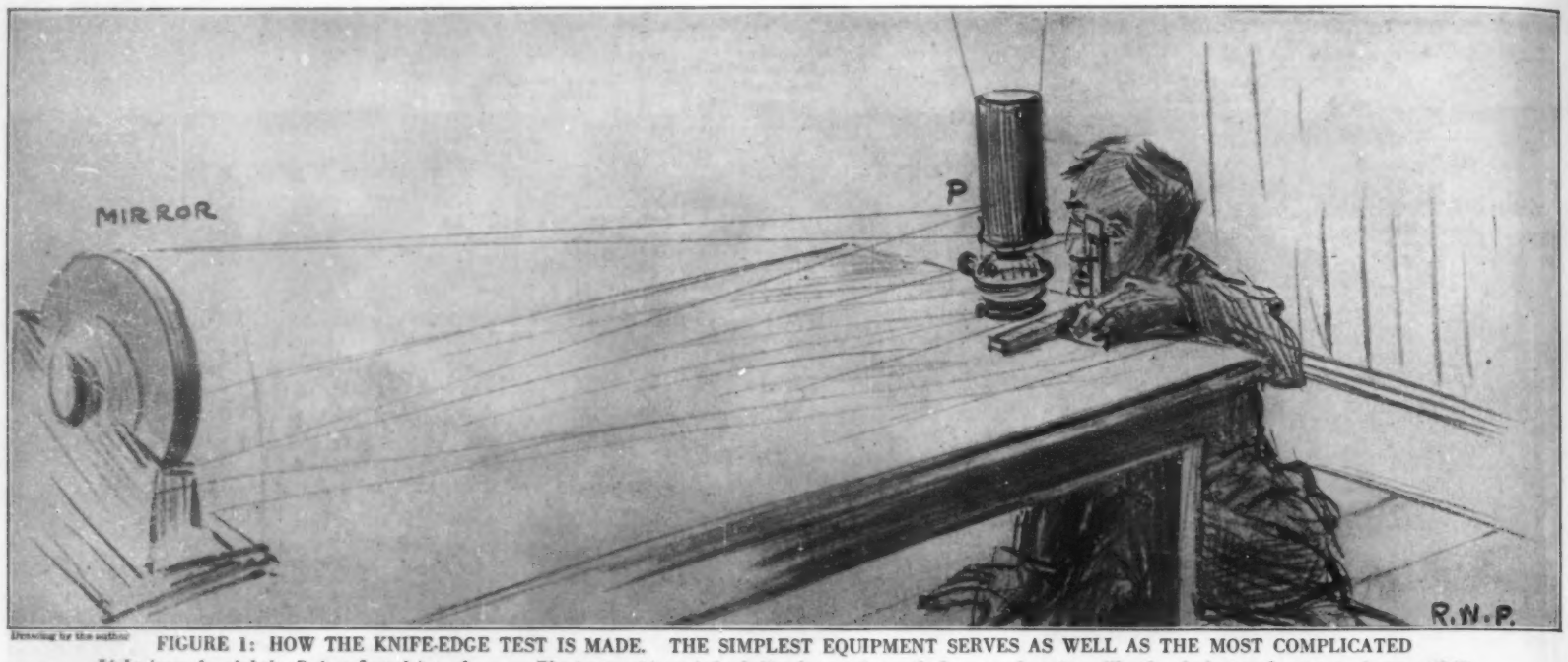
And to us Professor Cockerell sends the following lines, which he conceives as if they were a fragment from a play:

"O, every-girl, within your breast a beating heart
Records the pulse of Nature, has its part
In the great order of the circling suns.
For all creation's one, a single purpose runs
Through warp and woof of time and space,
And you, and we, with steady mind must face
The thing that is, and learn to love its laws.
Thus may our *work* be fruitful and repay
The labor patiently bestowed from day to day.
Thus may we join in Nature's greater plan,
Unfolding through the ages since the world began.
Thus *health* becomes our friend, as we obey
The ancient laws of life, and search alway
To do her bidding.
Yea, not even Love
Dares scorn the fruit of knowledge, for above,
Within, without, must order reign supreme,
And law, unchanging, rules love's golden dream."

Professor Cockerell has been invited to write for the Scientific American, and he will doubtless show us that what we need is more natural religion in science.



Drawn by S. W. Chatworthy from details supplied by Dr. Thomas Gann :



Drawing by the author

FIGURE 1: HOW THE KNIFE-EDGE TEST IS MADE. THE SIMPLEST EQUIPMENT SERVES AS WELL AS THE MOST COMPLICATED

Light from the pinhole, P, is reflected into the eye. The interposition of the knife-edge produces shadows on the mirror like the shadowgraphs at top of pages 88-89

Mirror Making for Reflecting Telescopes

By Russell W. Porter, M.S.

Optical Associate, Jones and Lamson Machine Company

IN the reflecting telescope, *the mirror's the thing*. No matter how elaborate and accurate the rest of the instrument, if it has a poor mirror, it is hopeless. Conversely, a good mirror, even if it is crudely and simply mounted, makes a powerful and efficient astronomical tool.

We are concerned in this article with the shaping of the telescope mirror. This consists solely in giving the upper side of it a concave, polished surface. This surface is to be so nearly spherical that we shall first attempt to make it precisely so; and at the very last we shall alter it to the kind of surface familiar to us all in automobile headlight reflectors, and known among the highbrows as a paraboloid of revolution.

Such an automobile headlight has the property of throwing out from a concentrated source of light placed at a focal point near it, a beam of parallel rays. (See Figure 6.) We shall, however, use this reflector the other way around, that is, by receiving parallel rays of light from a distant object (star); and by reflecting them from a properly curved mirror we shall bring them to a point or focus (F, Figure 6).

Our curve, however, is so small a portion of this widely sweeping parabola (the black area represents the mirror) that it is extremely shallow, and so it nearly coincides with the superimposed spherical curve. At first, therefore, we shall seek to hollow out a spherical curve, later deepening it very slightly into the paraboloid.

Since the angle of incidence of a reflected beam of light is equal to the angle of reflection, the parallel, arriving rays will be reflected approximately to a focus whose length may be regarded as one-half of the radius of curvature, C-A, Figure 6.

Enlarging the mirror of Figure 6, A, we have in Figure 8 the essentials of the Newtonian, reflecting telescope. Light from a distant object falls down the tube to the mirror, and normally would, by reflection, produce an image at the focus, F. The converging rays are, however, intercepted at D by a small diagonal mirror or prism that delivers them to a lens called an eye-piece at the side of the tube, where the image is examined.

I will take as our standard, a mirror six inches in diameter, having a four-foot focal length. The beginner is not advised to essay a larger mirror for his first effort, since his difficulties will be found to multiply quite disproportionately as the diameter increases. If two flat glass disks (A, Figure 7) are ground together, one over the other, with an abrasive between, lo and behold!—the upper one becomes concave, the lower one convex. This is because the center receives constant wear, while the outer portions, overhanging part of the time, receive less wear.

A straight, back-and-forth stroke, in which a given point on the upper disk moves across one-third the diameter of the lower, has the property of holding the two surfaces spherical. This is due to the fact that spherical surfaces are the only ones which remain in continuous contact at every point when moved over each other in any direction. This fact is a veritable godsend to the amateur—and to the professional, too, for that matter—for he may go confidently forward through the different stages of grinding and polishing with the knowledge that his mirror will come out nearly as it will be when it is finally deepened into a paraboloid.

The depth of the curve increases with grinding, and is gaged with a template of proper radius. Since by our rule, the radius, A-C, Figure 6, of the

Drawing by the author

FIGURE 2: THE AMATEUR AT WORK

The best place to work is the cellar, where the temperature is reasonably constant, an essential condition

Drawing by the author

FIGURE 3: THE FOUCAULT, KNIFE-EDGE TEST

With a lamp and razor blade, imperfections of the order of a millionth of an inch can be detected

Drawing by the author

FIGURE 4

Preparing the pitch lap, or polisher

curve of the glass is twice its focal length A-F, a template is made from tin, with a radius of twice 48 inches, or 96 inches. Therefore a stick of wood (not a string, which would be elastic) should be tacked to the floor at one end so as to pivot, and a knife point held at the opposite end, or a sharpened nail driven through at the proper distance, should be used to scratch the desired curve to which the tin should be cut. For our six-inch mirror the hollow will come to about .05 inch deep.

The lower disk of glass is fastened to a pedestal or to a weighted barrel so that one can walk around it in grinding, or it may be held between one removable and two fixed buttons on the corner of a stout bench or table. (See Figure 2.) Using melted pitch, a round handle is attached to the upper disk, which is first heated in cold water to a slightly unpleasant warmth for the hand, taking care that no cold water drops fall on the warmed disk, for they might break it.

The grinding is done by placing wet carborundum grains of successively finer sizes between the two disks, care being taken after each size is used to wash all parts of the work entirely free of the larger sized grains, which would otherwise scratch the disk. The strokes are straight forward and back, the center of one disk crossing that of the other. The glass also rotates bit by bit in the hands, in order to present a new direction for each stroke; and from time to time, in order to prevent the wearing of the glass unsymmetrically, the worker shifts positions around the pedestal; or, if working on a bench, he turns the lower disk, called the "tool" (we shall discard this tool at the end) to a new position.

Each grade of abrasive is used long enough to remove the coarser pits left by the preceding grade, and it will save much time and labor in the polishing if a small quantity of washed 6F ("sixty minute") emery is used after the Number 600 carborundum.

All the preceding work is covered in great detail by Ellison in his book, "The Amateur's Telescope," which at the present time is the only modern book of this nature available. [Editor's note: See list of literature and materials, prepared by Mr. Porter and printed in the Digest department of the present issue.]

The bench and both disks are now thoroughly washed in order to remove all traces of grit, preparatory to polishing.

Pitch is melted over a stove. It is tempered by adding (not over the fire) sufficient turpentine until a cooled sample placed between the teeth will just "give" slowly without crumbling, or will show a slight indentation of the thumb-nail under moderate pressure. The pitch is poured (Figure 4) over the tool, which has been warmed in water, and dried, and when it is partly cool, the glass is wetted (in warm water) and pressed down on the pitch until perfect contact is obtained between glass and pitch. V-shaped channels an inch apart are now cut across the pitch at right angles to each other, to allow free access of the rouge and water to all parts of the glass. Do not center this system of channels or you may produce zones in the mirror. See Figure 11.

Rouge mixed with water is now substituted for the carborundum and the polishing is carried on to completion, using the same strokes as in grinding. The time thus far consumed in grinding should be about five hours; polishing may require nine hours, divided into "spells." Through all these operations Ellison, the author of "The Amateur's Telescope," goes with painstaking care, anticipating the pitfalls into which the tyro inevitably falls. Were I to emphasize one caution over another, it would be the care required in preserving complete contact between the glass and the pitch lap surfaces while polishing.

If one-third strokes have been maintained in grinding and polishing, the surface of the glass will be nearly spherical. How shall we find out? The

Drawing by the author

FIGURE 5

Cutting channels in the pitch lap

method I shall now describe is one of the most delicate and beautiful tests to be found in the realm of physics. By it, imperfections of a millionth of an inch on the glass can be detected, and all the tools required are a kerosene lamp and a safety razor blade! This method of testing mirrors, called the Foucault knife-edge test, was unknown until about 1850; before that time mirror makers were groping in the dark. Even the great Herschel—father of the reflecting telescope—did not know when his mirrors were right, except by taking them out and trying them on a star.

If an artificial star made by a tiny pinhole (use a needle point) in a tin chimney on a kerosene lamp (an electric lamp will not be suitable) were placed at the center of the sphere of which the mirror's curve is a very small part, all of that portion of the light that emerges from the pinhole and strikes the mirror, is reflected back to the pinhole; for these light rays are all radii of the sphere, and by reflection they must return as radii back to their source, the pinhole.

In practice, the pinhole is pushed over a little to the right of the center of curvature so that the cone of reflected light may clear the chimney and enter the eye, as shown in Figures 1, 3 and 9. The mirror is placed on its edge on some suitable support, at table height, in a fairly darkened room. The lamp

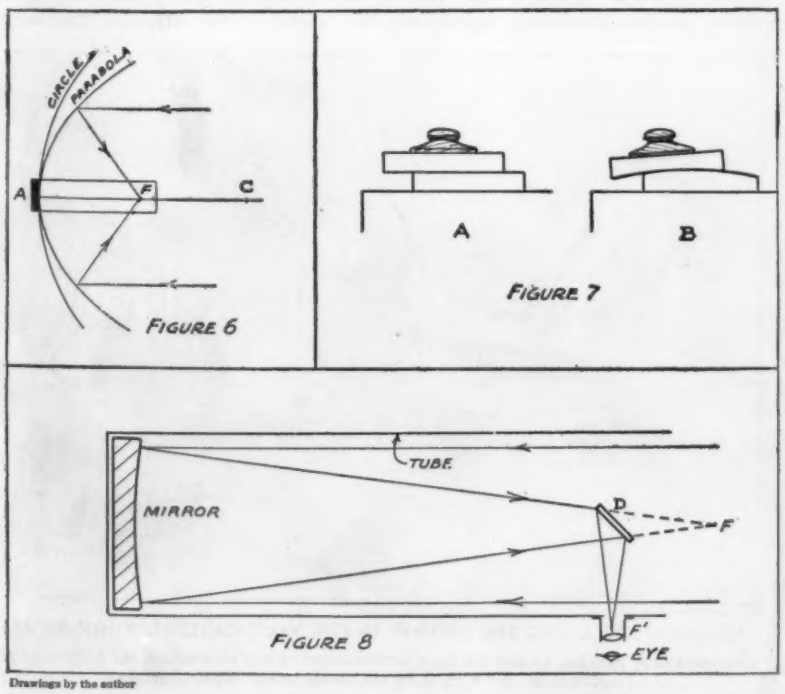


FIGURE 6

FIGURE 7

FIGURE 8

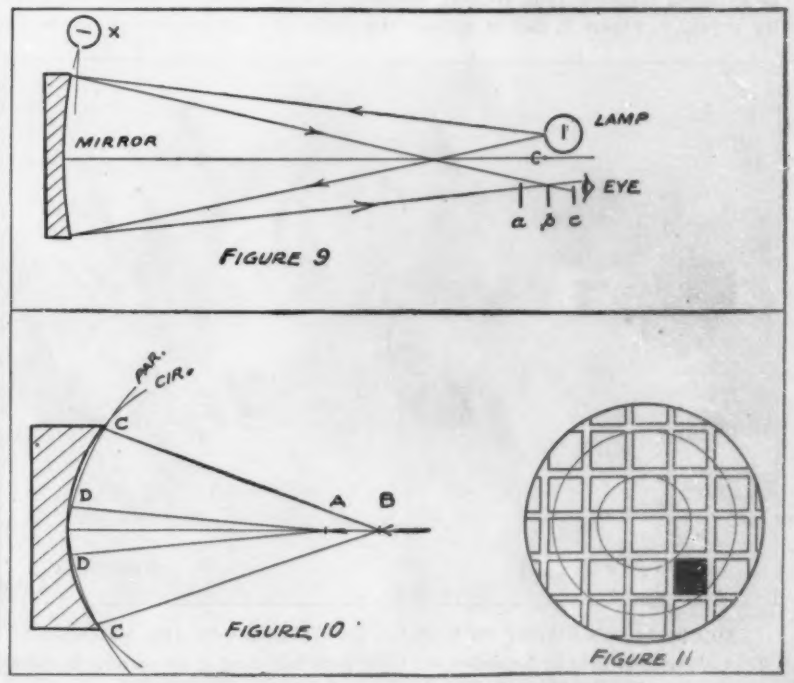
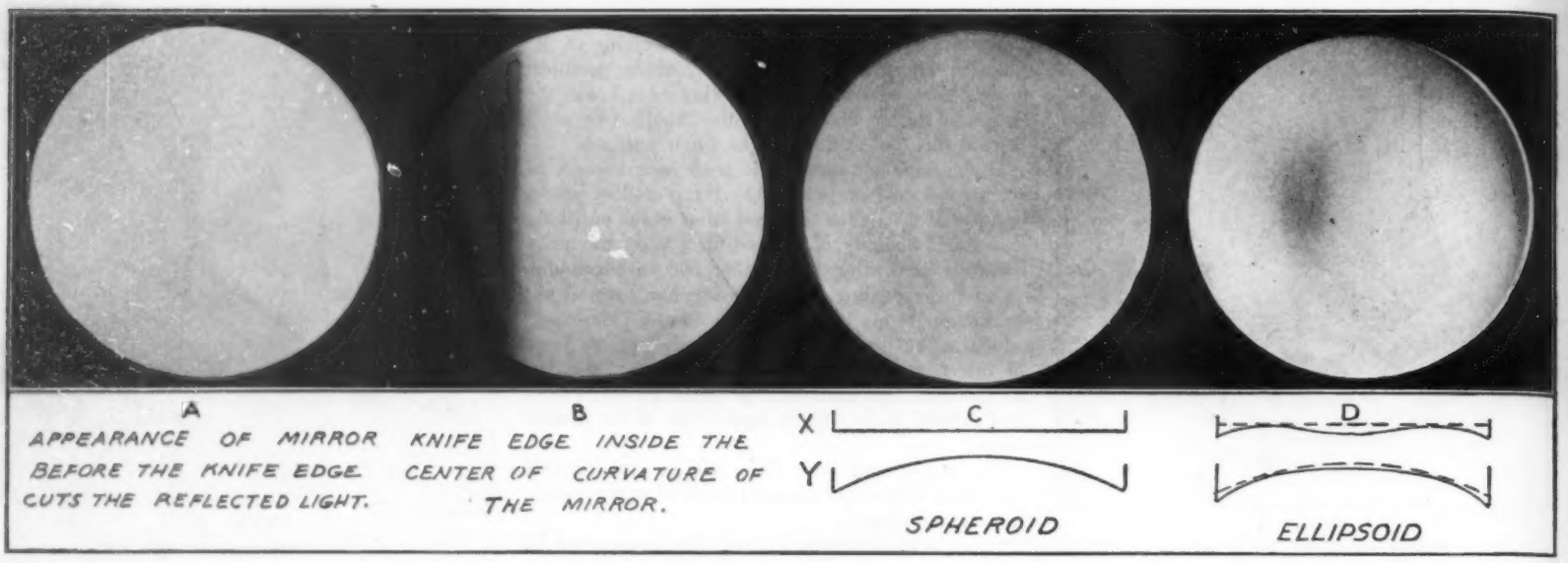


FIGURE 9

FIGURE 10

FIGURE 11

Drawings by the author



and the knife-edge (mounted on a block of wood) are placed on a table as shown, and about eight feet from the mirror, viz., at its center of curvature.

At first, considerable difficulty may be encountered in picking up with the eye the reflected cone of light. One way is to replace the tin chimney with a glass one, walk away from the lamp, keeping it in line with the mirror, when the image of the lamp will be seen in the mirror itself. Then bring the eye forward slowly, keeping the lamp image in view, and move the knife-edge to the right until it cuts off half of the image. The tin chimney is then put on and the image of the pinhole may be picked up somewhere near the edge of the safety razor blade. An alternate method is to use a piece of ground glass, which can be prepared by rubbing it with carborundum, to explore the neighborhood of the lamp, picking up the bright spot of light on it. As the eye approaches the position shown in the figures, this pinhole image begins to expand until a position is reached where the mirror is flooded with light over its entire surface—almost dazzling. (See shadowgraph A, above.)

Now comes the remarkable knife-edge test. The razor blade is moved in from the left until it cuts into the reflected cone of rays. If at a, Figure 9, that is, *inside* of the center of curvature, a shadow will come in on the mirror from the left, as might be expected (shadowgraph B). If, however, it cuts the rays at c, Figure 9, that is, *outside* the center of curvature, the shadow will advance over the mirror from the right, giving an appearance the reverse of shadowgraph B (or as B appears with the page turned upside down). But *at* the center of curvature, b, the mirror, if spherical, darkens simultaneously over its entire surface, becomes evenly gray (like shadowgraph C), and as the knife-edge is moved farther, it quickly vanishes. This is the simple test for a spherical surface, but it would be sheer luck if one's mirror appeared thus at the first test.

Viewed as just described, the surface of the curved mirror does not seem curved, but has the strange illusion of being flat. The observer *knows* it actually has a section like Y, under shadowgraph C, but it *appears* flat, like apparent section X, same place.

The surface having been brought to a sufficiently fine polish and to a spherical curve, the remaining work on the mirror, known as the "figuring," consists in slightly deepening this spherical surface into a paraboloidal surface, and this is done by polishing away the center faster than the edge. The final goal is to make the mirror appear, when the razor blade is beginning to cut off the light, like the shadowgraph E, F, or some intermediate depth, depending on the focal length, which need not be exact.

A common imperfection will be a raised or depressed zone, appearing like G and H in the shadowgraphs, whose true (lower) and apparent (upper) sections are shown beneath them. In the case of the raised zone the shadow has all the reality of a flat surface on which is a raised portion in the shape of a ring, the left slopes a, a, shadowgraph G, being in shade, the right slopes b, b, being in the light, *as though* the mirror were illuminated by a lamp placed on the opposite side of the glass from the knife-edge, as at X, in Figure 9. Figure 12 is an attempt to show how this imaginary lighting, at grazing incidence, *would* produce these shadows. Here the shadow of the man's fingers is superposed over the knife-edge shadow of a paraboloid. Conversely, a depressed zone (shadowgraph H) will have its lights and shades reversed.

Other characteristic shadowgraphs shown indicate curved surfaces well known to geometers under mouth-filling names. I would refrain from repeating them here for fear of throwing the novice into a panic of discouragement, but they must, nevertheless, be labeled for purposes of identification. Perhaps it will refresh the student's memory to note again the relations of these curves as shown in conic sections (Figure 14).

We have already considered the sphere whose section gives a circle (near top of cone, Figure 14). Its neighbors above (unlabeled) and below are the ellipsoid whose shadowgraph, shown at D of the shadowgraph series, presents a raised center and edge. The next curve is the parabola, its corresponding surface being the paraboloid, having an appearance the reverse of the ellipsoid, that is, an

Drawing by the author

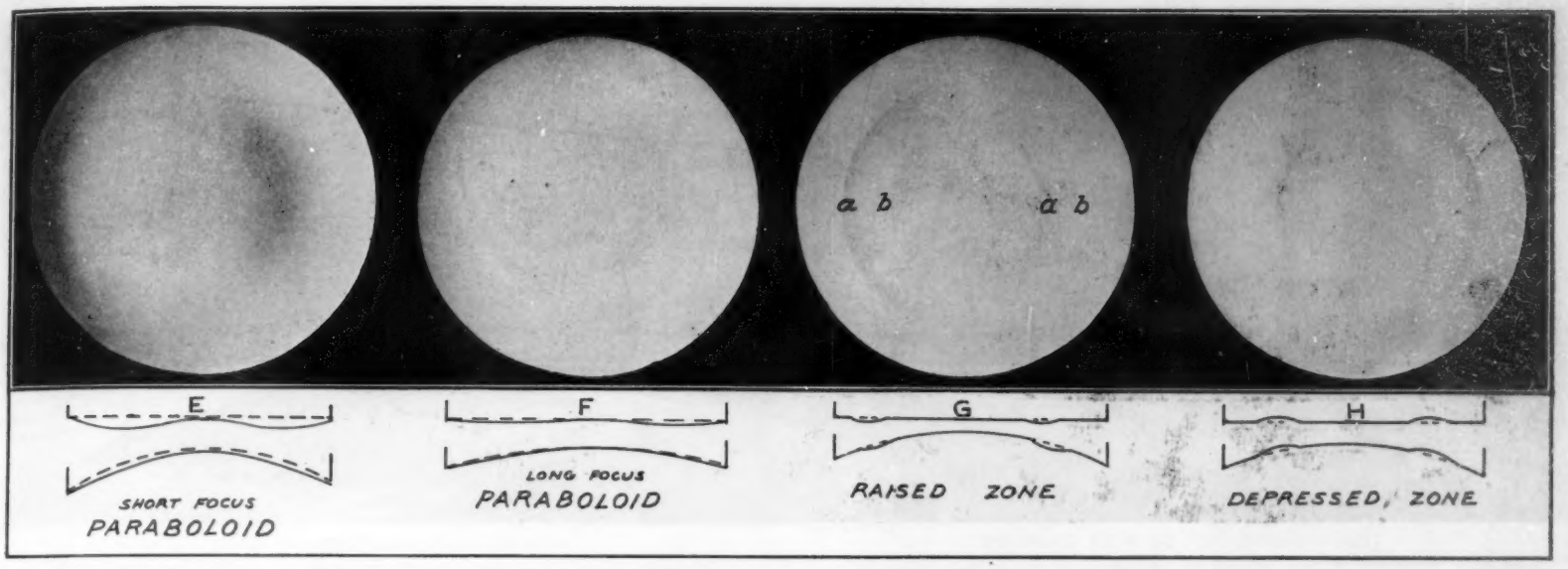
FIGURE 12: AN EFFORT TO EXPLAIN THE ILLUSION OF THE SHADOWS

The real source of light in the shadow test is the pinhole in front of the mirror; the mirror appears, however, as though illuminated from one side, grazingly

Drawing by the author

FIGURE 13: FIGURING THE MIRROR IS THE MOST CAREFUL WORK OF ALL

One method of figuring, or wearing away certain areas of the glass which the knife-edge test indicates are too high, is by the overhanging, elliptical stroke



apparently depressed center and edge, like a "Life Saver" candy with its central hole filled in. *This is the surface of a perfect telescope mirror.*

A paraboloidal mirror of short focus gives the stronger shade (shadowgraph E); a mirror of long focus gives a fainter shade (shadowgraph F). Our mirror, with focal length approximately six times its diameter, is about intermediate. The hyperboloid, corresponding to the hyperbola (Figure 14) is not shown in any of the shadowgraphs; its shadows are those of an exaggerated paraboloid, that is, quite dark, with the crest of the raised area nearer the edge of the mirror.

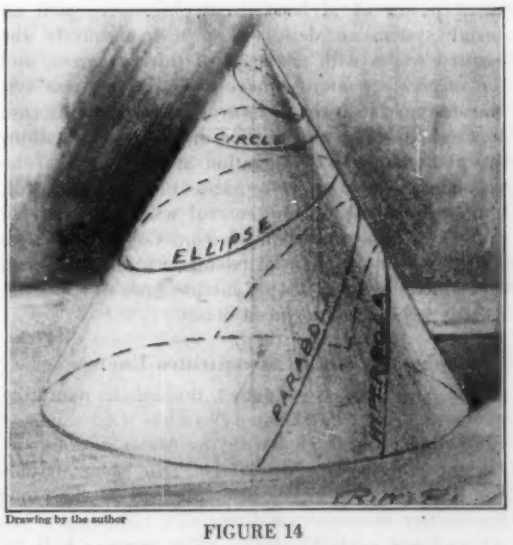
There is something uncanny about these shadows and shadowgraphs. As before mentioned, they should all be interpreted *as though* illuminated by light coming in from the right. But if one can force one's self to imagine these shadows as produced by light coming from the left, they will give an impression exactly the obverse. For example, in the case of the zone (shadowgraph G), one can change its appearance from a bas-relief to an intaglio, like shadowgraph H, by imagining it lighted from the left; and with a little experience one can make it perform in either manner at will. The rule is to consider the light coming from a direction opposite to the knife-edge. Ellison is almost unique among mirror workers in placing the light on the left and the knife-edge on the right.

Now all of these possible surfaces into which one's mirror may develop, are to be treated in the same way—the apparently raised portions are worn down to an apparently flat surface. There are several ways of accomplishing this result and all are described by Ellison in his book, at greater length than the present space could possibly permit. In general, a zone may be reduced by removing a part of the pitch lap, for it is evident that a square of pitch removed as shown in Figure 11 would tend to raise a zone on the mirror. The danger here is in producing unexpected zones, and the drawback of having to remake the lap (always a fussy job) if the altered pitch fails to correct the glass. Suffice it to say that, as explained in Ellison's book, there are several strokes and positions of the glass overhanging the tool that will bring almost any surface to that of the desired sphere, ready for the slight deepening into a paraboloid, without changing the lap.

This is the hardest, but at the same time the most fascinating, part of mirror making. Any one of these surfaces is so close to the sphere that no mechanical means could detect a difference between them. And yet, under the knife-edge, each type stands out glaringly with its own characteristic shadow—never to be forgotten when once seen.

Let us now assume that the mirror has been brought spherical—that it appears flat, under test. The curve now to be sought belongs to type E, F (shadowgraphs). This is very close to the sphere—so close that but a few moments polishing with a long stroke, or by letting the glass overhang the tool sidewise, will produce it. *Frequent testing is therefore essential during this crucial work of figuring the mirror.*

In Figure 10, the two curves represent sections of a sphere and of a paraboloid. It is evident that the parabolic curve is flatter at the margins, C, C, of the glass than at the central portion, D-D. Therefore light reflected from the pinhole will bring the



Drawing by the author

FIGURE 14

The curves we are dealing with are sections of a cone

rays from C and C to a point at B, on the axis of the mirror, further away than the point where the deeper part of the curve, D-D will focus them.

The distance between A and B is given from the equation, AB equals the square of the radius of the mirror, divided by its radius of curvature. Substituting for our six-inch mirror of four-foot focal length, we have, AB equals $(3)^2$ divided by 96, or 9/96, which is about one-tenth of an inch.

We now diaphragm out all of the mirror except a half-inch around the margin, and mark on the table the position of the knife-edge when the light darkens equally over the exposed portions. All of the mirror is then covered except a central portion two inches in diameter, and the knife-edge test is again applied similarly. This time, if the surface is correctly parabolized, we shall have to move the knife-edge toward the mirror one-tenth of an inch, as above determined. In both of the above tests, what we are really doing is to select limited parts of the parabola and regard each part as locally spherical; and then determine the degree of parabolization by ascertaining the difference in focal length of the respective spheres.

Silvering is now in order. The Bureau of Standards at Washington will provide, for the asking, a pamphlet describing the silvering process—how the glass is properly cleaned, the necessary chemicals and how they are used. Ellison also gives directions for silvering. It was some time before I produced a good, tough, silver coating, but if I had had access to the pamphlet referred to, there would have been no trouble.

Finally, if a lacquer (see appendix in Digest department), diluted six times with amyl acetate, is poured over the mirror and allowed to dry with the glass on its edge, the lustre of the silver will be prolonged for years, without in any way impairing its optical properties.

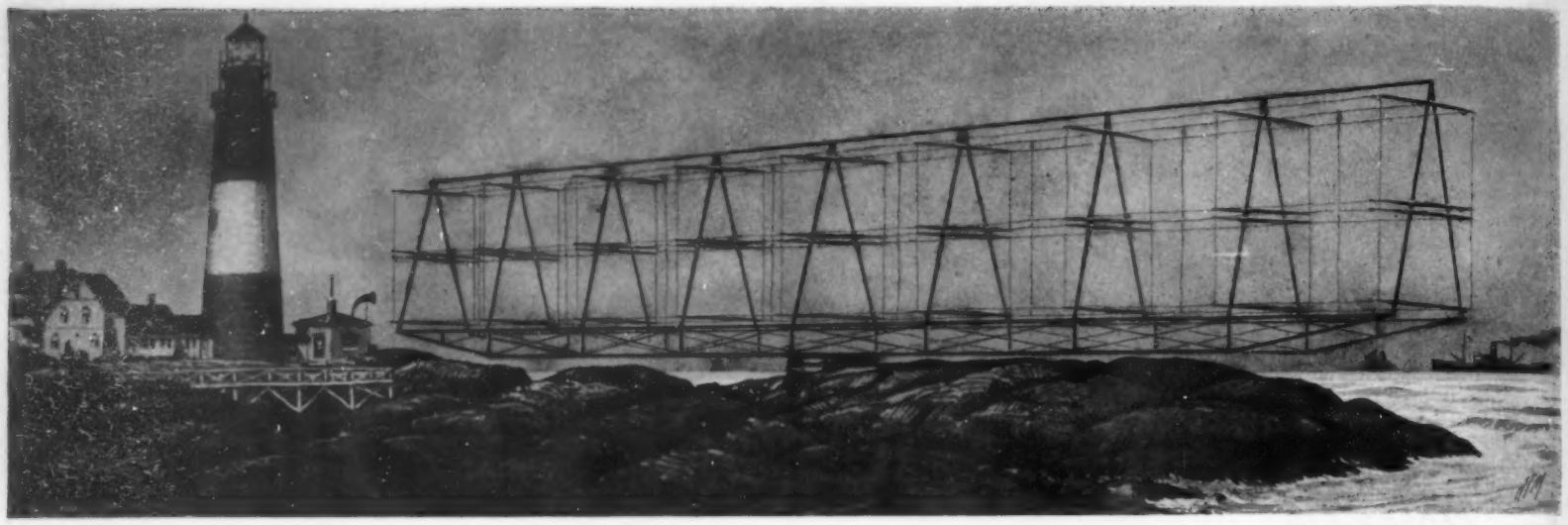
Nothing has been said here about scratches, effects of changed temperature on the glass, where best to work, testing with an eye-piece, testing at the focus, the dreaded turned-down edge, sticking of the glass, the various strokes and altered laps, and so on. Ellison covers them all.

Sir Howard Grubb, the well-known English maker of telescopes, is credited with the remark that "when the mirror has been brought to a complete polish, the work is about one-quarter done." And while it is true that the long interval of figuring with its interminable testing, tries the soul of the amateur, let him take pride in the fact that he is dealing with —and controlling—minute errors a thousand times smaller than those dealt with by a mechanic or machinist; and in the satisfaction of knowing that with this mirror made with his two hands he will be able to see the polar caps of Mars, Jupiter's bands, Saturn's rings, nebulæ, clusters and double stars—an instrument that would have excited the envy of even Galileo and Newton.

My experience has been this, that anyone who can use his hands, is possessed of moderate patience and sufficient reasoning ability to interpret the knife-edge shadows, can make a good mirror. Without these attributes he had better forego the venture.

Mirror making has many points to commend it. The tools are easy to make. The cost of materials is (compared to results) low. The work may be carried on at odd moments, day or night and in any available room of the home. In short, it contains the elements of a real indoor sport.

Next month Mr. Porter will describe a number of mountings suitable for the amateur's telescope.



Girdling the Earth With a Radio Beam

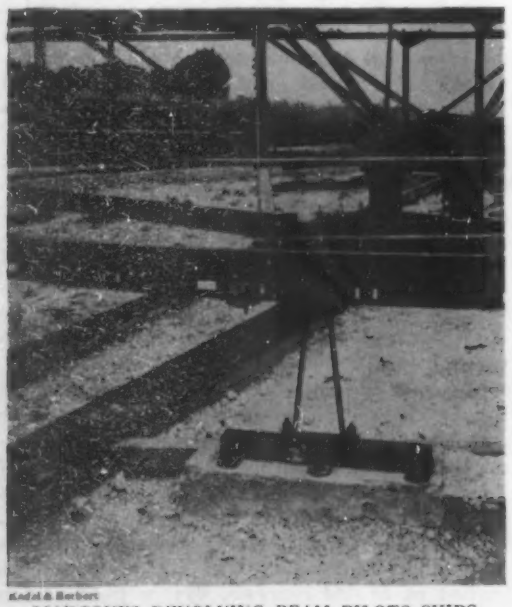
Marconi's Invisible Shaft to Encircle the Empire on Which the Sun Never Sets

By Orrin E. Dunlap, Jr.

THE various colonies of the British Empire are being linked by Marconi's latest development, the short-wave beam transmitter, which concentrates radio energy as a searchlight reflects light in a definite and desired direction.

Finishing touches on installations of this up-to-date system are being made near Montreal, by the Marconi Wireless Telegraph Company of Canada, for direct communication with England and Australia. The transmitters are located at Drummondville, forty-five miles east of Montreal and the receiving stations are at Yamachiche, approximately the same distance from Montreal, but twenty-five miles north of Drummondville.

These Canadian beams will be the first links to be forged in the world-wide, imperial wireless net. An agreement made with the British Postmaster General on July 28, 1924, provided that the Canadian Marconi Company should construct a beam station in the Dominion for communication with stations to be built in England by the Marconi Company as contractors for the British Post Office. The definition of a beam contained in that agreement is that the sending and receiving stations are capable of working simultaneously, the sending station to have an input power of at least twenty kilowatts, with an aerial system so designed as to concentrate the emitted waves with an angle of thirty degrees, and the receiving section to have a similar antenna system designed to focus the waves at the receiving end. In England, both transmitting and receiving stations are to be capable of operation at the Central Telegraph office in London by means of remote control, and in Montreal, remote control will be used from the office of the Canadian Marconi Company. Each station is to be capable of communication at a speed of 100-five-letter words per minute each way, during a daily average of eighteen hours.



Radel & Herbert

MARCONI'S REVOLVING BEAM PILOTS SHIPS

On the lower frame of this revolving structure can be seen the contact plates or the make-and-break mechanism. The plates represent Morse characters and as the ring on which they are carried revolves and passes the contact breaker, signals corresponding to the Morse code are broadcast

New System Concentrates Energy

The Australian Government, through its operating company, the Amalgamated Wireless (Australasia) Limited, has contracted with the Marconi Company for the erection in Australia of two beam stations for high-speed service. It is planned to have one transmitter communicate direct with London and the other direct with Montreal. The stations will be designed and equipped for maintaining communication twenty-four hours daily throughout the year and for duplex operation with both countries at high speed. It is expected that these stations will be open to handle public messages by March, 1926.

Plans are also under way for the installation of beam stations in India and South Africa for contact with London.

Marconi has pointed out that a tremendous waste of power occurs in the modern transatlantic commercial stations, which he believes are destined to be scrapped and replaced by the short-wave beam installations. The ability of the new system to concentrate energy saves electrical power and makes the method far more economical than the present high-frequency alternator or vacuum-tube installations, which radiate waves to all points of the compass.

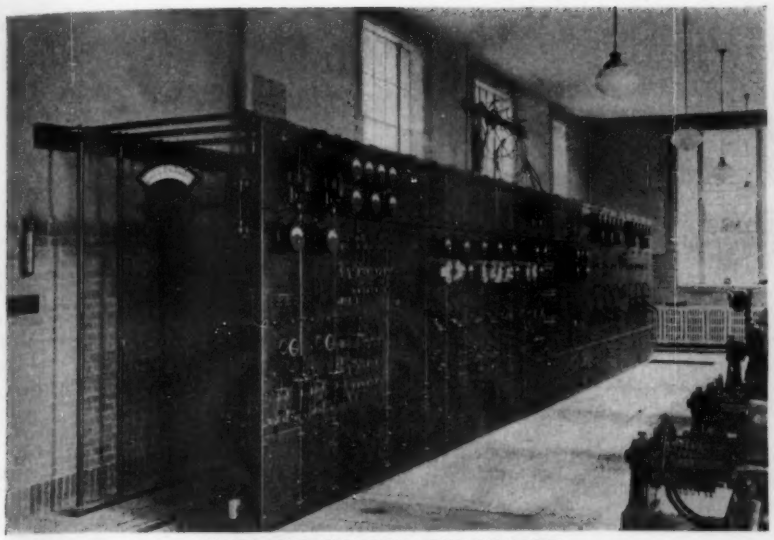
Marconi, in his inaugural address as president of the Royal Society of Arts in London, said, "Most people may now agree with me that wireless waves are far too valuable to be broadcast in all directions, especially when it is desired to communicate only with one particular place, and I do not understand why, for example, messages which may be intended for Canada or South Africa should be scattered simultaneously, pretty well over all the rest of the world. I can well understand the utility of the non-directional stations for many naval and marine purposes, and of course for broadcasting; but for ordinary efficient communication between fixed places, or between one country and another, I think the right and logical thing to do, if possible, from the point of view of secrecy and economy, is to concentrate all the radiated energy into a beam directed toward the country or place with which it is desired to communicate.

"The number of available wavelengths is very far from being unlimited; and if a wavelength which is

Radel & Herbert

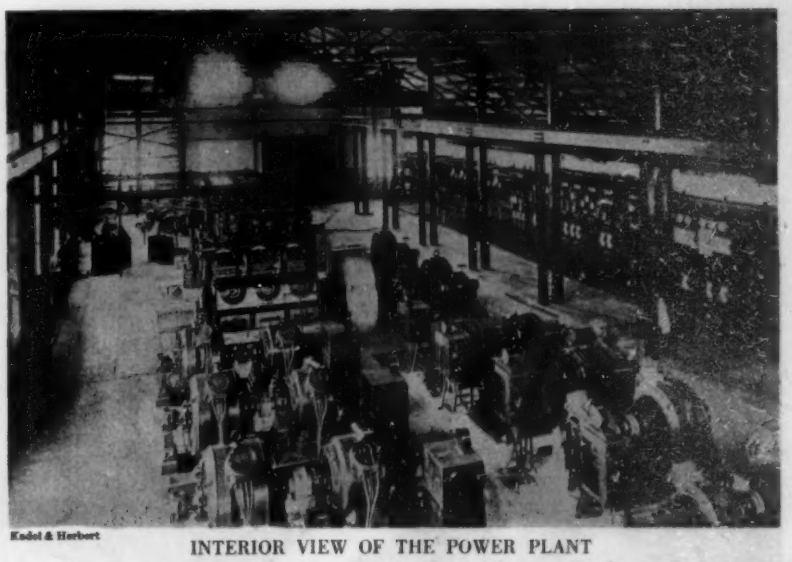
SENATORE MARCONI IN THE RADIO ROOM

The inventor of wireless for the past ten years has been devoting his energies to the development of the beam system of transmission and reception. With the assistance of C. S. Franklin, experiments using the reflector method, with very short wave lengths, were carried to a successful conclusion



MAIN DISTRIBUTION SWITCHBOARD

This control board guides the current of the beam transmitters at Drummondville



Kadel & Herbert

INTERIOR VIEW OF THE POWER PLANT

These generators supply the energy for the Marconi beam at Dorchester, England

being utilized for communication between England and India is allowed to spread to Africa and America, it would most probably interfere with the free use of that wave in these countries."

Senator Marconi explained that, while the limitation of the working period of a beam to practically the hours of darkness constituted an undoubted disadvantage, still the economical advantages, together with the reliability and possibility of working this system at much greater speeds than would be feasible with present high-power, long-wave installations, went far to convince him of its practicability.

"Results of experiments," said Marconi, "have fully confirmed my expectations in regard to the behavior of the various wavelengths over great distances. I have no doubt that the information gained will render possible the installation of comparatively low-power stations capable of establishing and maintaining commercial services by day and night between England and the most distant parts of the globe. The low cost of this system, both in capital and running expenses, compared with that of the existing type of stations, must prove to be very great, and should bring about the possibility of reduction in telegraph rates for all long-distance communication, besides making direct communication with smaller outposts of the Empire remunerative.

"Already the size and power of some of the most modern long-wave stations is becoming a serious financial problem. The newly equipped station at Buenos Aires, for example, was designed primarily for communication with Europe over a distance of about 6,000 miles. It employs 800 kilowatts and an aerial supported by ten towers, each 680 feet high. This station usually works on wavelengths of about 12,000 and 16,000 meters. Another example is the British Post Office station located at Rugby, which employs 1,000 kilowatts and an aerial supported by sixteen towers, each 820 feet high."

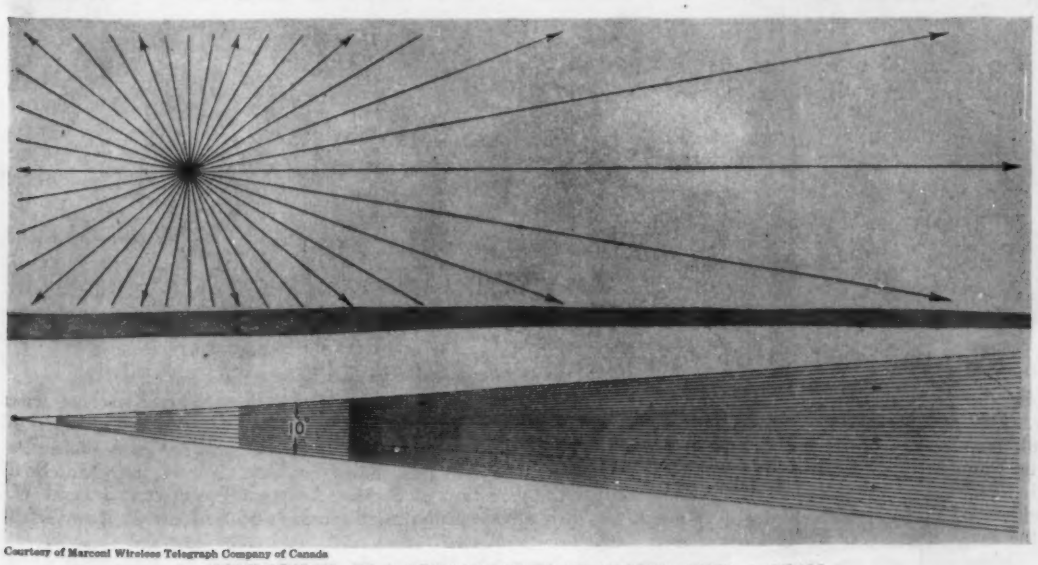
Radio Beacon Guides Ships

A ten-kilowatt beam station projecting its radiation in a narrow ten-degree band becomes, so far as a distant receiver is concerned, the equivalent of a 360-kilowatt transmitter, radiating broadcasts in all directions. The engineers explain that the possibilities of concentration do not end here. A similar reflector can be used at the receiver, whereby energy can be drawn from a wide area of the advancing wave front and concentrated on the receiver, giving a further increase in the total power intercepted.

Due to the size of the reflector which, for a given degree of concentration, increases with the square of the wavelength employed, the system is more adaptable to short waves, up to 150 meters. It is estimated that it will be possible to handle more traffic during two hours with one of these short-wave beams between Australia and London than could be disposed of by a 1,000-kilowatt broadcasting plant during twenty-four hours.

The masts of the beam transmitters are arranged in a straight line at right angles to the direction in which communication is to be established. The aerial and reflector consist of a number of vertical wires suspended from triatics attached to crossarms of the masts.

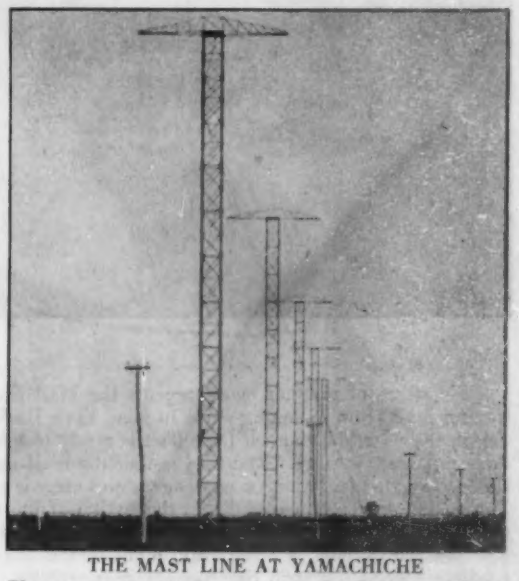
Senator Marconi has also developed a special application of the beam system in the form of a radio beacon for the purpose of guiding ships. Signals are projected in a narrow beam and a different Morse letter is flashed as the beam points to different points of the compass. The observing officer on the vessel listens in and hears a series of Morse characters as the beam sweeps slowly past the ship. The letters he hears tell him by reference to a chart the direction the beam is pointing at any given instant, and therefore, the middle letter of the series of letters he detects gives him his exact position. The signals are radiated on the six-meter wavelength. The cost of the receiving apparatus is low and consequently the system is brought within reach of all ships, even tugs and trawlers. One of these stations, which works automatically, is located at South Foreland, England.



Courtesy of Marconi Wireless Telegraph Company of Canada

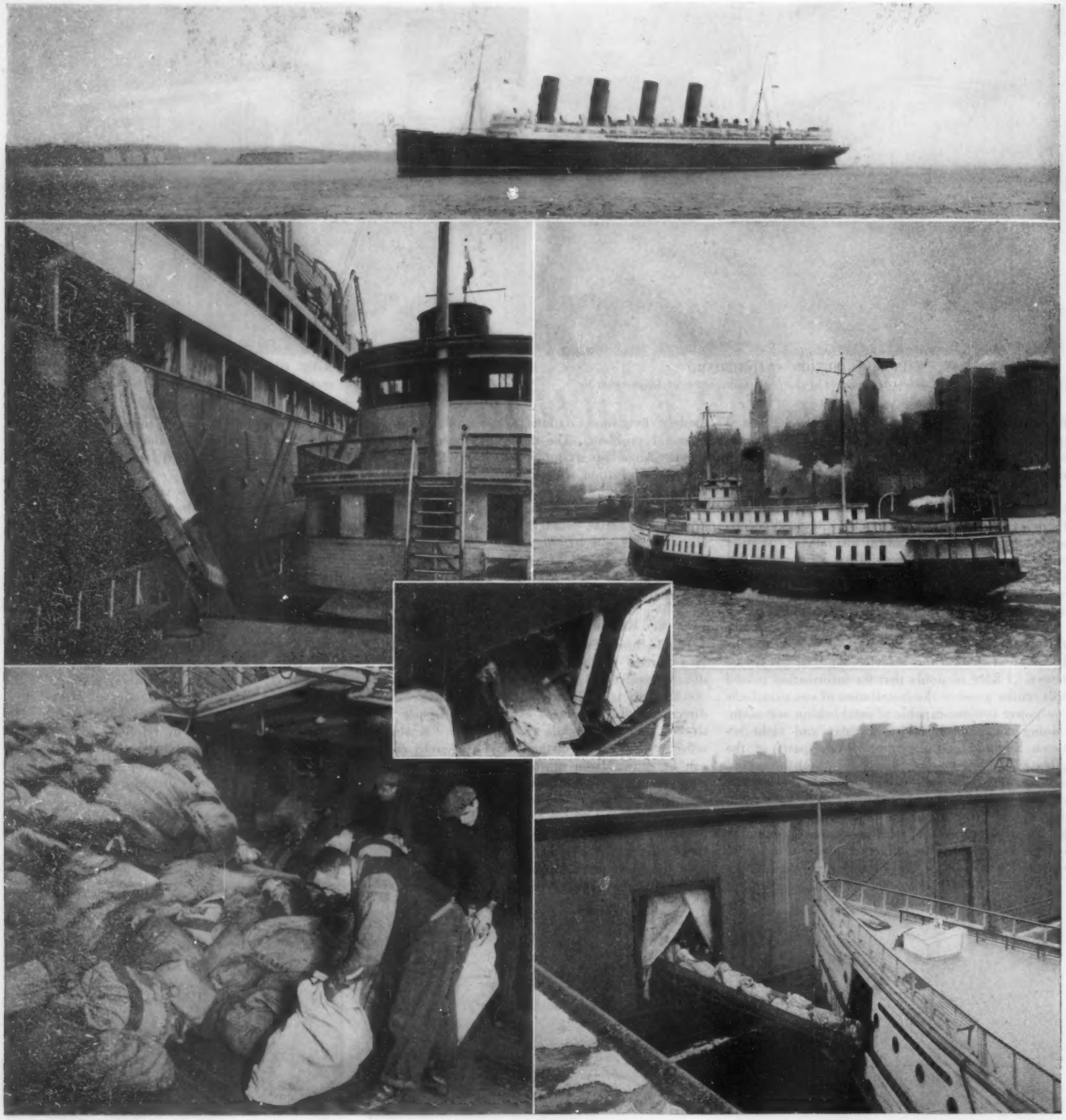
COMPARISON OF A BROADCAST TRANSMITTER WITH A BEAM

The top diagram illustrates how the ordinary transmitting station radiates energy in all directions. The lower illustration shows a transmitter radiating a beam of 10 degrees. Note how the use of a reflector concentrates the energy uniformly in a narrow angle. If the distant receiving station lies within the arc of that angle, it will intercept more than 36 times more power than it would if the same energy were radiated uniformly throughout the 360 degrees of a circle



THE MAST LINE AT YAMACHICHE

These towers support the receiving and reflecting aerials for reception of waves from England. The towers are similar in construction to the masts at Drummondville used for transmission to England



Neptune and the Postman

No stress of weather ever prevents the Mail Boat Service from taking off foreign mail from incoming ships in New York Harbor. Day and night, every day in the year, the staunch little fleet is ready to take off from one to fourteen thousand bags of mail. The idea is that the mail can be transferred while the Public Health Inspection of passengers and crew is taking place at Quarantine. The saving in time in expediting the mail is from twenty-four to forty hours over the old method of handling on the pier, and, in the case of mail for the Far East, the saving is often from eight to ten days. Chutes and nets are in readiness when the incoming vessels drop anchor. When the mail is transferred, word is flashed to the Post Office and trucks are entrained to handle the mail. During 1924, 1,552 vessels arrived in Quarantine with mail cargoes, a total of 960,448 bags being received. If laid end to end these bags would extend over 750 miles. On Christmas Eve, 1924, the *Olympic* arrived with 14,151 bags and five mail boats were required to transport it. We are indebted to Mr. W. J. Treloar, who has direct supervision of the Service, for many courtesies to our artist and editor on several trips down the Bay. The Harbor Mail Boat Service comes under the direction of Second Assistant Postmaster General W. Irving Glover, and Mr. R. P. Williams, Superintendent of the Railway Mail Service, New York.

The upper view shows *S.S. Mauretania*, slowing down at Quarantine. She will not have long to wait, for the *President* (middle right) left her pier an hour ago. On the left is shown the chute and protective net. On the lower left is shown part of 4,000 bags of mail. The insert shows an open port, used on some vessels. At the lower right is the ramp taking off the mail at the pier.

Canned Radio Telegraphy

With Phonographic Records the Army Is Learning Modern Methods of Signaling

By Albert G. Ingalls

JOIN the army and learn radio telegraphy! In the World War most of the personnel of the army was required to learn semaphore signaling, a system of transmitting intelligence letter by letter by means of motions of the two arms of the signaler. When, however, these men actually reached France they found that semaphore and wig-wag signals, useful in old-fashioned warfare, were of little use. Electricity works faster, is more accurate and decidedly safer to the signalman than a method which renders him conspicuous.

Telegraphy has now become so important in the army that a large proportion of its members, both officers and enlisted men, must know how to read the language of dots and dashes. How to telegraph by radio or by wire is now being taught to army men in a standardized, uniform manner, by means of permanent wax phonograph records, exactly the kind into which many business men now dictate their correspondence.

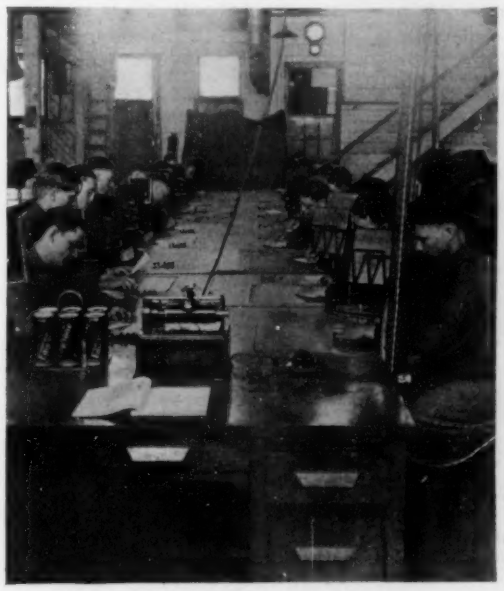
Proficiency a Matter of Aptitude

These records do not instruct orally like the phonograph which instructs you in your morning setting-up exercises, but they actually telegraph. When you put one on an ediphone you actually hear a telegraph sounder or a buzzer at work, sending you messages in perfect, clear Morse or continental code. You can even make your own records and then sit back and "play" them, listening to your own style of telegraphy and picking out your own faults. Records of this sort, made originally by an expert telegrapher whose style of transmission surpasses that of the average erring telegrapher in smoothness, ease and clarity as much as legible handwriting surpasses poor handwriting, are now being used throughout the United States Army for instruction in both radio and Morse telegraphy.

In this manner every camp, unit and remote army post, whether in the United States or in the insular possessions, is provided with a mechanical tutor in this important branch of the signaling art. Moreover, beginners are insured against unconsciously acquiring the careless styles of telegraphy of many ordinary instructors. With the new system, which was originated by Captain John P. Ferriter, aided by Captain E. Allen and Master Sergeant E. E. Stradley, all of the U. S. Army Signal Corps, almost anyone, whether a proficient telegrapher or not, may instruct in either Morse or radio code telegraphy.

Recently the writer visited Camp Alfred Vail at Little Silver, New Jersey, not far from New York City, in order to see the new method of instruction in actual use.

The school was in full blast. One large class consisted of officers, mostly captains and lieutenants, seated before long tables, silently absorbing radio signals from headsets and printing the received signals on paper. Several foreign officers were included in this class. The other class, consisting of



THE ARMY IS WIDE AWAKE

Learning radio and Morse telegraphy from wax records, at Camp Alfred Vail

enlisted men detailed to Camp Alfred Vail from various units of the army, was copying telegraph signals from ordinary Morse sounders. In both cases these signals proceeded mechanically and electrically from a small ediphone whose spinning record made the groups of dots and dashes and spaces which compose the signals.

Both officers and enlisted men receive identical training, the course lasting nineteen weeks. At the end of this period they are turned out capable of receiving and transmitting telegraphic communications at the rate of twenty words per minute, a good rate of speed for telegraphy. One might logically expect the officers, since they are chosen as officers because of superior intelligence, to learn the art of telegraphy more rapidly than the enlisted men. Yet this is not the case. Neither class excels. Telegraphy is not acquired through the exercise of the intelligence, and the only criterion for predetermining a man's natural *aptitude* for it is an aptitude test, such as the one devised by Captain Ferriter.

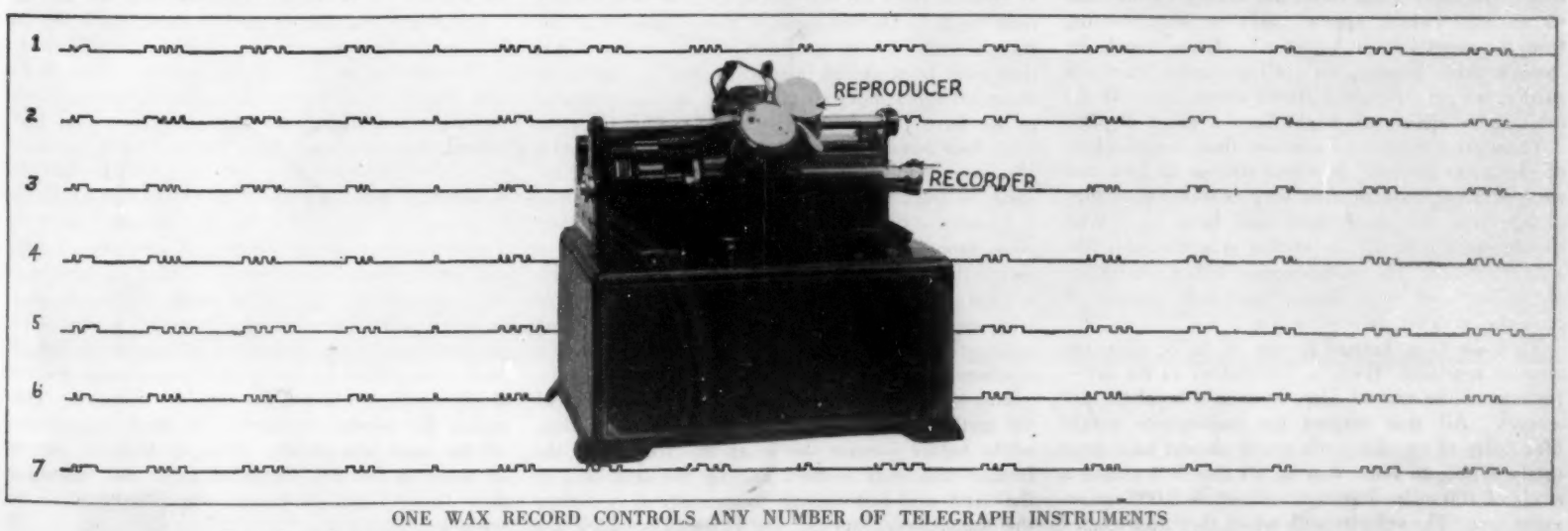
The aptitude test simply consists in making telegraph signals, pronouncing their alphabetical equivalents after each one, and then testing the memory of the men for the retention of these sounds. No effort is made here (or at any subsequent time) to teach the students dots and dashes. Instead, the groups of dots and dashes that constitute letters are memorized as groups.

Individuality in Sending

The mechanical principles on which the records are made are fundamentally quite simple. Alternating current is supplied from a microphone howler at the frequency of 800 cycles per second, a rate which furnishes an agreeable tone for buzzer telegraphy. A telegrapher chosen for his excellent transmitting ability—telegraphers put as much individuality into their sending as there is in ordinary handwriting, and some of it is as careless—sits down and makes and breaks the flow of this alternating current with a telegraph key, making the required signals. This causes a stylus to bite into the groove of the wax record for each alternation while the key is closed. What is produced on the wax record is a series of little indentations, not very dissimilar from those on any phonograph record.

When such a record is placed on the ediphone and run through, this series of indentations makes and breaks the circuit, and through other connected apparatus this actuates the diaphragm of the headset on the student's ears in corresponding manner.

This system of teaching radio telegraphy would be invaluable in time of sudden wartime expansion of the Army, for it would enable millions of men to learn radio telegraphy from instructors who were comparatively unfamiliar with telegraphy. It would be especially useful in the Navy, the National Guard and in the Organized Army Reserve. In short, it replaces a slow, laborious and only partly uniform method of teaching telegraphy with a standardized method capable of rapid expansion in time of war.



ONE WAX RECORD CONTROLS ANY NUMBER OF TELEGRAPH INSTRUMENTS

Few telegraph operators can transmit uniformly perfect telegraph signals by hand, as these comparative records of letters demonstrate

What Are Shooting Stars and Meteorites?

The Vast Majority of These Brilliant Objects Are Smaller than a Pea

By Henry Norris Russell, Ph.D.
Professor of Astronomy at Princeton University
Research Associate of the Mt. Wilson Observatory of the Carnegie Institution

ONE cannot watch the sky for an hour on a clear evening without seeing star-like specks of light, which flash across the heavens, and vanish in the twinkling of an eye, leaving perhaps a faint trail of light behind them, which endures for a moment or two longer. Everybody who knows anything about the heavens knows these "shooting-stars" are thousands of times nearer than even the moon, and yet are really part of the astronomer's field of study. They are little lumps of matter, which have been pursuing their paths through space for ages, moving through the perfect vacuum of interplanetary space, without disturbance.

Fate at last carries them toward the earth, and no sooner do they enter the outer confines of our atmosphere than they meet with such friction that in an instant they flash into incandescent vapor and vanish.

Once or twice in a lifetime, we may have the good fortune to see a fireball—a great meteor, which lights up the landscape like the moon, or sometimes far more brightly. Such fireballs take several seconds in their flight—as against half a second or so for a shooting-star, and leave a long, luminous train, which sometimes remains visible for many minutes.

Grandest of all—but, alas, not likely to be seen in our generation—is a shower of shooting stars, such as appeared in 1799, 1833, and 1867. In 1833 the sky for hours was alive with meteors, coming far too fast to count. It is estimated that, at the height of the shower, they came at the rate of 200,000 per hour, or more than fifty a second.

Behind these unusual spectacles lie causes very similar to those of the familiar shooting-star. A fireball is simply a larger mass of the same sort of material—sometimes big enough to get clear through to the surface of the earth, and fall as a meteorite; and a meteoric shower results when we meet a swarm of the smaller particles, and they fall not singly, but by thousands.

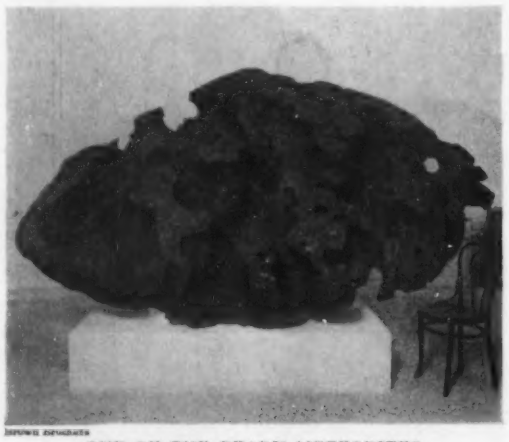
Meteors Thick as Snowflakes

It is common knowledge, again, that in such cases the swarm is pursuing a definite orbit about the sun, and that, in several cases this coincides with the orbit of a comet. Most of the half-dozen comets thus distinguished are faint, but Halley's comet has its meteors (which appear early in May, coming from the constellation Aquarius). Even though the comet's orbit passes four million miles from the earth's, we get stragglers almost every year. If the orbit came closer, we might have a great display.

These great swarms of meteors, then, are members of our solar system. It seems strange at first that we should not know of their very existence until they plunge into the atmosphere and burn up. Why should not the swarm be visible at a distance, like a faint comet? The answer comes with a realization of the extreme and almost incredible tenuity of even the greatest meteor swarm.

Take the great Leonid shower of 1833, when the meteors appeared "thick as snowflakes" in the sky—perhaps at the rate of fifty, or even a hundred, per second. All that entered the atmosphere within fifty miles of an observer's zenith should have been easily visible to him—that is, all that fell within a circle of 100 miles diameter, and nearly 8,000 square miles area. The velocity with which they approached the latter was a little over thirty miles per second, so that in a single second, more than 200,000 cubic miles of meteor-swarm precipitated themselves into the air within full view. This accounted at most for a hundred meteors. Each one, therefore, had about 2,000 cubic miles of space to itself!

These meteors are small affairs, too. We do not know just how big they are, but we can figure out how much energy they send out in the form of light. Assuming that their "luminous efficiency" is comparable to that of artificial light-sources, we



ONE OF THE PEARY METEORITES

Although most meteors are members of our solar system, some of the large meteorites come in as wanderers from the vast depths of interstellar space

reach an estimate of their total energy, and, knowing their velocity, obtain their mass. In this way it can be shown that even a bright shooting-star probably weighs only a few milligrams—less than a pebble a tenth of an inch in diameter.

One such sand grain or tiny pebble to a thousand cubic miles of empty space would be enough to make a finer star-shower than has ever been recorded. A "cloud" of this sort and ten million miles thick, would be almost absolutely transparent, and utterly invisible, even by reflected light. The most tenuous comet is presumably enormously dense.

But what of the sporadic meteors, which, coming at random from all directions, may be seen on any dark night? On the average, these come in at the rate of eight or ten an hour, which indicates that they must be scattered in space something like forty thousand times more sparsely than in such a swarm as we have just discussed. Each meteor must be some four hundred miles from its nearest neighbors. Do these belong to the solar system, too, or are some, at least, visitors from interstellar space?

There is only one real test to decide this: if they come from outside they must be moving faster in their orbits than if they belong to our system. But to apply this test might seem hopeless, for shooting-stars shoot across the sky so fast that no one can well estimate their speed. But there is "safety in numbers"—that is, in statistical methods of study.

Just after sunset, an observer is on the side of the earth which is at the rear in its orbital motion, while before sunrise, he is at the front. In the former case, only meteors moving the same way as the earth and fast enough to overtake it can enter the atmosphere, but in the latter, all which are moving the other way, or the same way and slowly enough to be overtaken, will be caught. Many more meteors should, therefore, be seen per hour before dawn than after sunset, and this is found to be the case.

If the meteors moved more slowly than the earth, we would get none at all in the evening. The faster they move, on the average, the less will be the difference in the hourly numbers. Hoffmeister, from a careful study made in this way finds that, to account for the observed numbers, the average speed of the meteors must be large—so that most of them must be visitors, entering our system from outside.

In autumn, the earth's north pole is tipped forward—in the direction of the orbital motion—and in spring, backward. More meteors per hour are therefore seen in the fall than in the spring.

For the great meteorites, which get clear through the air without being consumed, and fall to the ground, the distribution is quite the reverse. More fall in the afternoon and evening than in the morning hours, and more in spring than in autumn. Most of these bodies, therefore, overtake the earth, and are moving around the sun in the same direction as the planets.

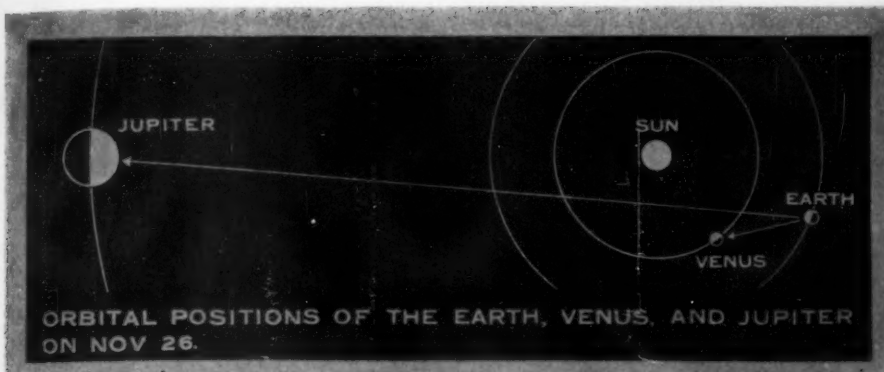
Where Do the Meteors Come From?

Does this mean that these larger bodies are members of our solar system—tiny outliers of the asteroid group? It looks so at first sight, but we must not be too hasty. Bodies which meet the earth will plunge into the atmosphere very swiftly and have an enormous amount of energy to dissipate—so much so that the heat produced may consume them entirely, while slower moving ones may be but partly volatilized, leaving a residual mass to fall to the surface, like a spent projectile.

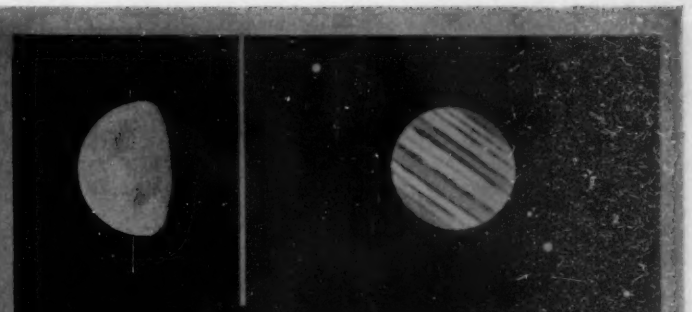
Such large bodies which may weigh hundreds of pounds have millions of times more energy to turn to heat in the atmosphere than the little shooting-stars. If they turn the same proportion of it into light, the tales told by competent observers, of fireballs which lighted up the whole landscape like day, far outshining the moon, are entirely credible.

When such a body is observed from several stations, its real path may be worked out and, if the time of its flight is also known, its velocity may be found. To estimate the duration of an unexpected and remarkable phenomenon, which lasts at best but a few seconds, is, however, very difficult.

The existing records of this sort usually indicate that meteorites and great fireballs are moving very rapidly when they enter the atmosphere—so fast, indeed, that they must have come in on hyperbolic orbits from interstellar space. It would be difficult, however, to select a type of observation more liable to systematic error, that is, to habitual under- or overstatement, than the duration of such phenomena; and until some more accurate method of determining the time of flight is invented, the results may be taken with some caution. It seems, nevertheless, probable that some at least of the meteorites which have been picked up and placed in our museums are really wanderers from the depths of space. This makes the general similarity of their composition all the more remarkable. Most of them are masses of stone, a few are lumps of iron; but, wherever they come from, they are surprisingly alike in nature.



ORBITAL POSITIONS OF THE EARTH, VENUS, AND JUPITER ON NOV 26.



TELESCOPIC VIEWS OF VENUS AND JUPITER

Courtesy of the "Illustrated London News"

Two Brilliant Planets, Jupiter and Venus, in Conjunction

Everyone was impressed, a short time ago, by the striking spectacle presented in the southwestern skies, when the two most brilliant planets of our solar system were near their conjunction. Here was a sight that for untold thousands of years has periodically excited the awe and stirred the imagination of man. Two heavenly lights draw nearer and nearer together, pass and gradually separate. What does it mean? How these interesting events actually occurred, in terms of astronomy, is clearly depicted in the upper corner of the drawing, by the artist, Mr. Scriven Bolton, himself an amateur astronomer.

Hillside terraces of scrub and weeds will prevent ruinous washing. This is in the Piedmont region of North Carolina

Shall We Throw Away Our Soil?

The Soil Is Our Most Valuable Asset. Are We Treating It Right?

By Hugh Hammond Bennett
Bureau of Soils, U. S. Department of Agriculture

THE soil is literally *man's most valuable asset*. From it he must derive the bulk of his food for all time—if we leave out of the calculation possible additions from the laboratory of the synthetic chemist, who thus far has given us little to supplement the products of the soil.

On this continent, we have a fixed area of land, and it is the most variable thing we possess. Some millions of acres of this land have value neither for crops nor for trees, and it is of little worth for grazing. Many millions of our acres can be used for growing trees, but not for growing tilled crops. The remainder of our soil varies from mediocre to highly productive farm-crop soil.

Some of this land is so thin that it will produce almost nothing without heavy applications of fertilizers. Some is highly susceptible to ruinous washing; other areas are adapted to wheat; others are adapted to grass only, or to rice, cotton, tobacco, and so on. Certain types of soil require one kind of fertilizer treatment; other types require other kinds. Probably all types of soil after long usage, will need some kind of soil amendment for maximum production.

Importance of Soil Analysis

At present we know neither the extent nor the exact location of these many and varying classes of land. Nevertheless, we should know, because if the character of the soil from place to place is not known, it will be impossible for the agricultural experiment stations to pass on to the farmer, with relative certainty of their correct application, the results of the crop and fertilizer tests carried out upon the definite kinds of soil. Nor will it be possible for a farmer to leave an overcrowded agricultural community and take up land in a new and unfamiliar locality with any degree of certainty as to the productivity or crop adaptation of the soil.

Without definite knowledge regarding the extent and distribution of the varying grades of land it obviously will be impossible for economists to determine either precisely or approximately where the nation stands with respect to the farm land situation.

Fortunately the situation is not as bad as the foregoing statements seem to suggest. Actually, thanks to the foresight of the Department of Agriculture for beginning a soil survey of the country some twenty years ago, we do know something about the places of occurrence and the quality of our soils—at least for a very considerable area of them. Although less than one-third of the country has been covered by this United States Department of Agriculture soil survey, enough has been done to point to definite lines for attacking the problem of *making better use of the soil*.

An example will explain one of the important results accomplished for a large area: The state of North Carolina, although including none of the rich, lime soil like that covering the great Black Waxy Belt of central Texas, nor any of the "super soil," such as that spread over the Mississippi River bottoms, produces, nevertheless, more cotton per acre than any other of the important cotton states. Not only that, but in recent years it has come up to fourth place among all the states of the Union in the value of its crops. Yet one-third of its area is exceedingly mountainous, other large tracts consist of undrained coastal swamps, and there is not within its limits a single acre of the black prairie soil that enticed swarms of home-seekers to cross the Alleghenies to the Missouri and Mississippi valleys.

SUBSOIL HEALTH IS ESSENTIAL

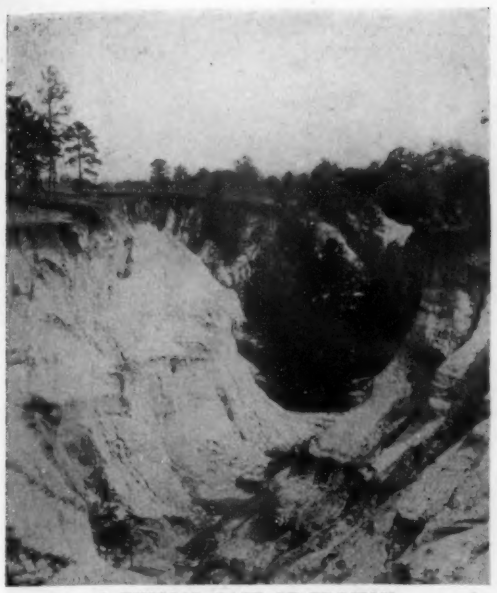
The productivity of a soil often depends upon the character of the subsoil. Therefore, soil surveyors bore into and take samples of the subsoil down to three feet deep

How did this large production per acre happen? What were the underlying causes that brought about this marked agricultural advancement? For one thing (there were a number of causes), the "Tar Heel State" began more than twenty years ago to study, to classify, and to map its soils. As soon as the important types of soil were recognized, and when their place of occurrence was determined, subexperiment stations and outlying test plots were established upon these delimited soil type areas. Moreover, the old-fashioned method of sending out state-wide bulletins of advice, based on fertilizer experiments carried out upon a *single* type of soil at the old central station, was abandoned.

North Carolina Farmers Progressive

Instead, from the work done on the different North Carolina soils, the farm advisors gleaned information which was definite. It was applicable to farms situated on land *like* that where the tests were made. It was found, for example, that the red clay of the Piedmont granite lands needed little or no potash either for cotton or corn, and therefore farmers were advised not to use this fertilizer for these crops on land of this nature because the granite rocks from which these red lands have been formed are already rich in potassium, and the soils derived from the disintegration of that kind of rock are usually amply supplied with this form of plant food. In the sandy, coast country, on the other hand, where the soils were found to be wholly different, it was learned that potash was needed in liberal amounts.

The North Carolina farmers were told what to do for each kind of soil. They did it and the results expressed in money value for the crops grown is



A TYPICAL CASE OF EROSION

Trees growing in the bottom of gullies arrest washing and start soil regeneration by causing the gullies to fill

told effectively by the Government statistics referred to in a preceding paragraph.

With an abundance of fertile land in young America there was not so great a necessity for the adjustment of crops to the soil. But with a change from an expansive to an intensive type of agriculture —which change a diminishing land supply must inevitably bring about—the need for closer observance of the principle of fitting crops and fertilizers to soil variation will be more and more imperative.

In various parts of the United States, corn is being grown on land, which, while very suitable for other crops, is but poorly adapted to corn. Vast areas of semi-arid and arid grazing land have been planted to crops where there is rarely enough rainfall to insure more than a pittance of yield. Many farmers are living wearisome lives trying to derive meager sustenance from stubborn clays and droughty sands, where only trees can really succeed. Unscrupulous and ignorant land agents are selling low-grade and worthless land to credulous farm-builders as "the richest soil on earth"; the writer recently saw stunted grape fruit and cotton on land sold at $300 an acre to a hopeful farmer, new to the locality, where the soil was so charged with toxic alkali salts that an average yield per acre of one crate of fruit or twenty pounds of cotton could not be hoped for.

Thousands annually buy farm sites solely upon the representations of land agents, often without seeing the land. Others misjudge the crop capabilities of land after they have seen it, usually because it is impossible for the average man to be a soil expert, or because his judgment succumbs to the convincing enthusiasm of the selling agent. These mistakes are often made in localities which have already been covered by soil surveys. Many people do not know that both the Government and most of the states are constantly publishing new soil maps and soil reports, which not only describe the various soils in detail, but which show on carefully made maps the precise location of the different classes of land. These maps and reports have been issued for numerous representative areas throughout the agricultural regions of the country. They can be had without cost from the State Experiment stations, or from the United States Department of Agriculture. They can also be seen in most public libraries.

Soil problems, whether they concern the home vegetable garden or the large farm, can best be diagnosed by the soil technicians of the experiment stations and departments of agriculture when the type of land has been identified.

Erosion Destroys Ten Million Acres

A chemical analysis alone can not be depended on to determine what a soil may need. Many other facts must be known, such as the character of underdrainage and aeration, subsoil condition with respect to hardpan or gravel beds, and texture of both the soil and subsoil. If, in the absence of regional soil maps, the type name of a particular kind of soil cannot be determined, it is sometimes possible to have this done by sending samples of the soil and subsoil to competent authorities.

Soils not only vary in productiveness, adaptability and needs, but in their power to withstand erosion. Once a gully is permitted to get beyond control, some types of soil, such as the red, sandy loams of the Atlantic and Gulf Coastal plain and the wind-deposited silts bordering the bottoms of the Mississippi and Missouri Rivers (the loessial regions), melt away almost like sugar in water. The problem of saving the soil from destructive erosion over millions of acres of sloping land throughout the humid portion of the United States is one of the most difficult tasks confronting agriculture. In a single county in the southern Piedmont section of the Atlantic Coast states an area of 90,000 acres formerly rated as good farm land was classed by a recent survey as *rough, gullied land* unfit for anything but scant grazing and timber. Most of this land can be reclaimed to agriculture only through

A REGIONAL SOIL MAP

Detailed maps are available for the asking. The various kinds and grades of soil are shown in different colors

centuries of cumulative rock decay and the other natural equally lengthy processes of soil building.

Probably not less than eight or ten million acres of land, once of medium to good value for agriculture, have been permanently destroyed or made temporarily unfit for cultivation by soil wash. Areas many times as great as this have been seriously impaired by the same process. Erosion or soil wash is impoverishing our sloping farm lands at a very much faster rate than are the crops which are being taken from them. Recently the Missouri Agricultural Experiment Station showed by actual measurement that within 24 years, erosion has removed seven inches of the surface soil from an important type of Missouri farm land, which is plowed regularly to a depth of four inches. In bluegrass sod, however, the same type of soil erodes at the rate of only seven inches in 3,547 years.

Surely something more than is now being done, should be done to check this enormous wastage. It is a national duty—if not the personal duty of every citizen who can think beyond the absolute needs of the moment—to take some active part in opposition to unrestrained soil erosion. If one is unable to start a woodlot, let him establish a plot of permanent sod, or build hillside terraces in some field which, in its present condition, is too steep for the growing of clean-tilled crops.

NOT USED TO THE BEST ADVANTAGE

Here we see unprofitable cotton growing on deep, loose sand which is much better suited to the raising of peaches, berries and early vegetables

THE USE OF FERTILIZER IS OFTEN IMPERATIVE

As is clearly demonstrated in this photograph. No fertilizer was used on the rows at the left; but the rows on the right were completely fertilized

The Standing Stone Forests of Wyoming

By Guy E. Mitchell
United States Geological Survey

THERE is a log of the *Sequoia gigantea*, commonly known as the Big Tree, that has been lying on the ground in one of the National Parks of California for nearly 400 years the wood of which as yet shows no signs of decay. But there are trunks of Sequoias standing in the Yellowstone National Park whose measure of age is in the hundreds of thousands, indeed millions of years. They too are perfectly preserved, moreover they will endure for another millennium. Nothing in the wonderland of the Yellowstone is more wonderful than its standing stone forests, older than the surrounding rocks themselves and of harder texture.

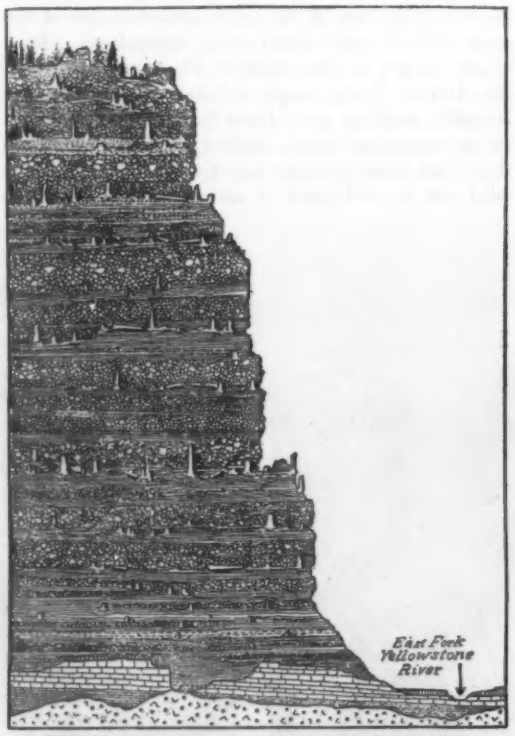
During the ages the Yellowstone River has cut a great trench 2,000 feet deep, down from the top of the plateau to the present bed of the river. On this high plateau stand the trunks of a petrified forest embedded in rock which was once soil.

There Were No Men

At the bottom of the gorge where the river flows you may see the standing stumps of another petrified forest immeasurably older than the stone forests 2,000 feet above, while in the space between, jutting out from the canyon walls, and on the steep slopes are the stone stumps of thirteen other stone forests—fifteen in all, one above the other, the most remarkable evidence of fossilization in the world.

The story is one of the dense vegetation of an early world, of terrific volcanic eruptions submerging the forests and of chemical metamorphism on a gigantic scale—natural phenomena of millions of years ago.

In the very long ago, before the birth of the Yellowstone Plateau, before the Yellowstone River, giant forests of conifers flourished upon a low, flat country, only a little above sea level, bordered by the peaks of great volcanoes; a magnificent forest it was through which roamed the gigantic beasts of the early world. There were no men. Then one day came a vast eruption. The volcanoes threw forth countless tons of material, and this first forest, the lowest one of the fifteen as you view them from the bed of the Yellowstone Canyon, was completely buried under the masses of falling ashes and pumice. Then rains followed and Nature's chemistry began its slow and perfect work, the silica-charged waters "pickled" and preserved and gradually changed to stone the entire forest.



FOSSIL FORESTS OF YELLOWSTONE PARK
Section through 2,000 feet of Specimen Ridge, showing a succession of fifteen buried forests. The broad valley was carved out after the forest beds were deposited

After this first forest was buried quiet was restored in the land and the volcanic material on top of the forest was reduced to soil and a second forest sprang up. The geologic evidence points to the possibility that the roots of this living forest may have actually entwined among the topmost fossil branches of the first forest.

Forests on Top of Forests

After many centuries the volcanoes roared forth again, and the second forest, the stumps of which you may see a short distance up the slope of the canyon wall, was likewise buried and petrified as had been the first one. Then grew up another forest and again came a deluge of ash and scoria submerging it. Such tremendous processes were repeated again and again during a vast period of time until 2,000 feet of volcanic material had been showered over the land by the volcanoes and the great Yellowstone Plateau built up to its present height while no less than fifteen forests had grown and been entombed, one above the other.

Finally the volcanoes ceased their activity, forever we hope, man came into the possession of the earth, and the growing forest of today appeared. But even before this, the disintegrating action of rain and frost set in, uncovering the topmost stone forest and cutting the great Yellowstone gorge through its plateau, in the heart of which today you may read the story of its origin and see the trunks and stumps of its many forests as they have been converted into the hardest of agate.

Many of these trees, standing on the slopes and steeper hillsides rise to a height of 20 to 30 feet, and are covered with lichens and discolored by frost and rain. Millions of years old and of solid stone, as the traveler observes them standing upright among the stumps and trunks of the living forest he will

A ROCKY LOOK-OUT

A giant petrified stump nine feet in diameter. In the background is the Yellowstone River 2,000 feet below

have to take a second and closer look to convince himself that they are really fossil trunks.

Some conception of the magnitude of the volcanism which submerged these forests may be gained from a comparison of the results with those of historic volcanic eruptions. The Vesuvian submergence of Pompeii and Herculaneum, for instance, under a mass of volcanic ejecta which has recently been dug through, was a matter of a few feet, yet here in the Yellowstone we see 2,000 feet of solid rock all consolidated from volcanic ash and pumice.

Many visitors to the Yellowstone pass by the petrified forests without notice, for they are less spectacular than the giant geysers and other wonders of the Park though really far more remarkable. But, as you ride up the trail that meanders along the smooth river bottom, if you are on the lookout you will note that the cliffs on the right-hand side are covered with a multitude of these bleached stone trunks looking for all the world like stumps of ordinary decaying wood, and in the precipitate middle portion of the mountain face you will see rows of pillared trunks standing out on the ledges that resemble the columns of a ruined temple. On the lesser slopes, farther down, but where it is still too steep to support vegetation, save a few pines, the petrified trunks fairly cover the surface. Many years ago these appeared to Professor Holmes of the Smithsonian Institution, the discoverer of the Yellowstone petrified forests, to be the remains of a recent forest.

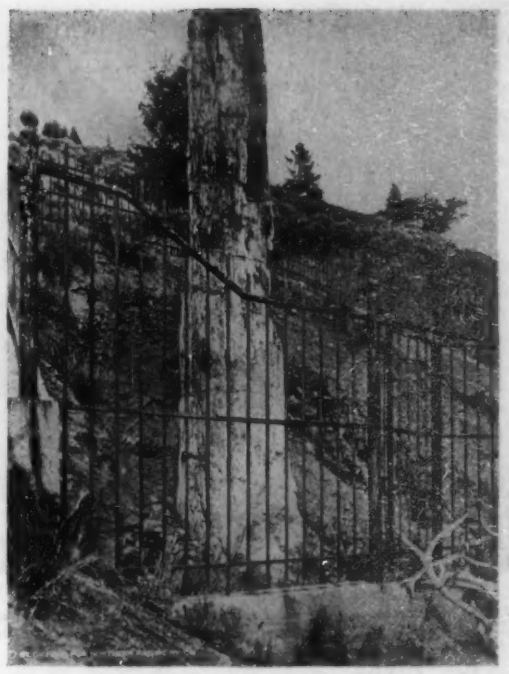
The largest petrified trunk in the Yellowstone is a little over ten feet in diameter, which includes a portion of well-preserved bark while at the summit of Specimen Ridge stands a trunk twelve feet high that is twenty-six and one-half feet in circumference, without the bark. This giant tree, literally older than the hills, is a true *Sequoia* and is so closely allied to the modern redwood of California as to be, even to the botanist, hardly distinguishable from it. It would be interesting to know the height to which this tree attained ultimately; but it is believed by geologists, from what is known of its living representatives, that it may have been well over two hundred feet.

Alaska Once Had Tropical Climate

In other parts of the petrified forests there are trunks fifteen and twenty feet high and in some cases the bark and knot holes are perfectly preserved. Some of the trunks are hollow in the center, the cavities lined with brilliant amethyst crystals.

Petrified woods are interesting objects for microscopic study even by the layman, who may have a microscope with a capacity of thirty or forty diameters. When thin sections of the "wood" are carefully ground to a thickness of one three-hundredths of an inch and placed under the microscope they show the original structure of the wood perfectly, all the cells being distinct. By studying these thin sections Dr. F. H. Knowlton of the United States Geological Survey has identified a great variety of species of the ancient world in the various fossil forests of the Yellowstone.

Besides the redwood and many other kinds of conifers Dr. Knowlton has discovered species ranging from the vegetation of a tropical clime to that of the north temperate, indicating great changes in climate since the first forest of the Yellowstone was buried in volcanic ash. Among the species he has identified of these ancient natives of Wyoming are oak, sycamore, buckthorn, breadfruit, magnolias, bay trees, walnut trees, birch, persimmon, dogwood, ash, hickories, elms, cinnamon, figs and many other species which do not grow in Wyoming at the present time and some of which are found nowhere in the United States.

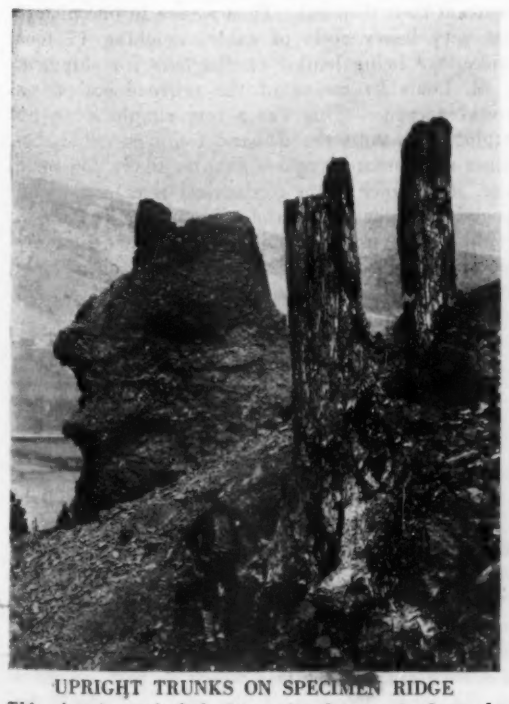


NOT FUEL FOR THE CAMPER

One of the many petrified trees in Yellowstone Park. The iron fence protects it from souvenir-gathering tourists

Petrified or fossil wood itself is no rarity. Stumps and logs of it are found in all quarters of the globe, from far northern points of arctic exploration to frozen points in the Antarctic. Even giant fossil palms have been found in Alaska, incredible as it may seem that that land of snow and ice should once have been almost tropical. But wherever found the trunks are prostrated and lie broken and scattered.

In the wonderful collection of petrified logs in Arizona the name "forest" is not strictly appropriate for the petrified trunks are all prostrate and evidently did not grow where they now lie. They apparently drifted down some ancient watercourse and lodged in a huge eddy or sand bank and later were buried under deposits of sand and clay. But the petrified forests of the Yellowstone stand where they grew.

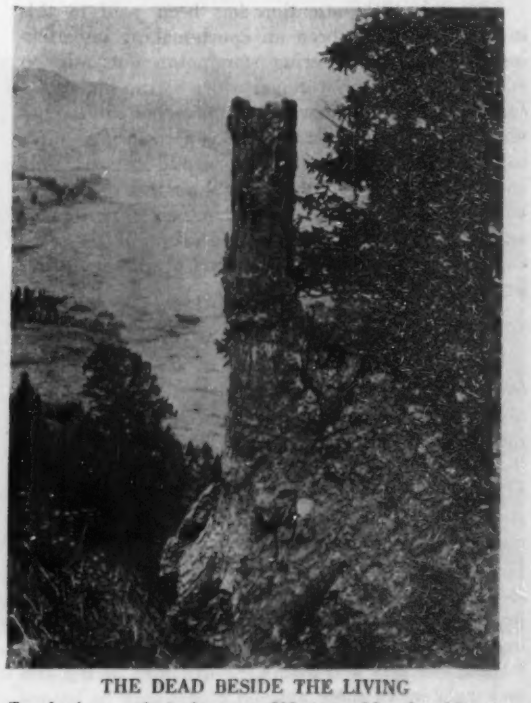


UPRIGHT TRUNKS ON SPECIMEN RIDGE

This view is particularly interesting because it shows the spreading roots of the petrified trees

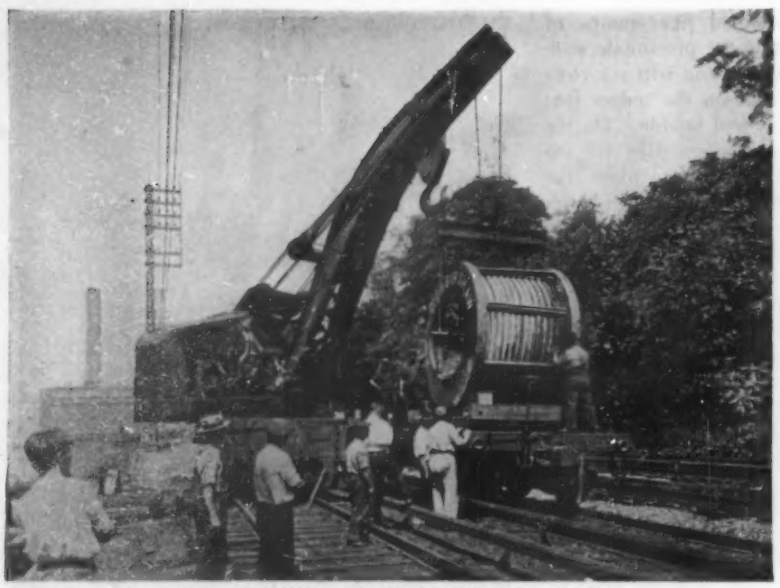
DR. F. H. KNOWLTON AT WORK

*He is examining an excellent specimen of the ancient redwood—*Sequoia magnifica, *he has named it*



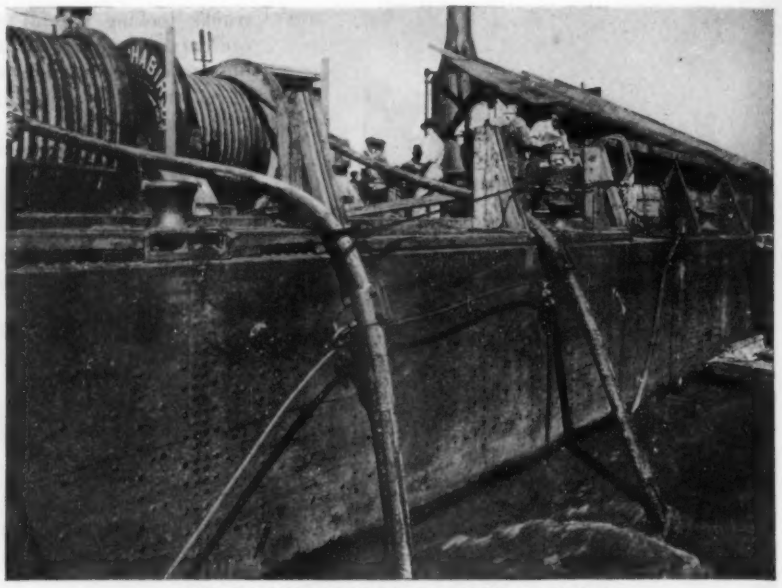
THE DEAD BESIDE THE LIVING

Trunk of an ancient pine some 500 times older than historic civilization standing alongside growing pines



THE WRECKING CRANE COMES INTO PLAY

Loading a reel of submarine cable onto a flat car by means of a wrecking crane. This reel weighed 17 tons and had to be placed directly over the trucks at the end of the car



CABLES GOING OVERBOARD FROM A BARGE

Note the swiftness of the current. The cables are clamped to a wire rope which is attached to an anchor to keep them from creeping downstream. Two cables were laid at a time

An Epoch-Making Engineering Achievement

The Laying of High-voltage Submarine Power Cables Across the Mississippi

By Francis A. Westbrook

NOT long ago a new type of submarine telegraph cable was laid across the Atlantic Ocean which marked a very great advance in the art of submarine telegraphy. At about the same time a group of submarine power cables to operate at 33,000 volts was laid across the Mississippi River at St. Louis, which also indicated an important advance in the art of power transmission. While the transmission of power, even in such large "blocks" as in this case, certainly seems a prosaic and impersonal affair when compared to the transmission of messages between people, it is nevertheless just as vital a matter to the welfare of mankind as is international communication.

Although little attention has been paid to this installation, it has been an epoch-making undertaking from the engineering standpoint, not only on account of the high voltage, which is the highest so far used in this country for submarine cables, but also because of the fact that it was necessary to splice together two sections of cable in mid-stream. This is the story of the solution of one of those problems which electrical engineers find it necessary to face with increasing frequency on account of the very rapidly expanding use of electrical power in all branches of human activity.

Cables of Unusual Size

The principal characteristics of submarine cables for power transmission on a large scale are that they are comparatively short—in this case half a mile; that they usually have three large conductors; that they operate at high voltage; and that on account of the number of conductors, thick insulation, lead sheathing and large armor wire, they are heavy, stiff and cumbersome to handle. Paper saturated with petrolatum, or vaseline, is the only practicable insulating material for such high voltages and the only possible way to make this waterproof is by surrounding it with a lead sheath which adds greatly to the weight, stiffness and diameter. An idea of the size and make-up of these unusual cables may be gained from the following:

There are three conductors of 350,000 circular miles each.

The conductors are sector shaped instead of round, so as to decrease the diameter of the cable after the three are "cabled" together.

The paper insulation around each conductor is 23/64 inch thick and in addition, insulation to a thickness of 9/64 inch is wrapped around the three assembled conductors.

The lead sheath is 9/64 inch thick.

There are 42 galvanized steel armor wires about ¼ inch in diameter.

The diameter of the finished cable is 4.4 inches.

JOINTS GOING OVERBOARD

When they are raised up, the cable barge is moved out from under them, the cables unwinding from the reels as it proceeds. The joints are then gradually lowered into the river, thus avoiding sharp bends

The weight of the finished cable is about 25 pounds per foot.

It is evident that cables like these cannot be installed across a river by a large steamer with all the necessary apparatus on board, but that smaller, easily maneuvered vessels must be used and the equipment for doing the work assembled especially for the purpose.

Although underground cables are being made for constantly increasing voltages, this rate of increase has been slower with submarines on account of the greater difficulty of making and installing them. The manufacturer who made these cables had never done anything just like it before, so it was necessary for his engineers to do the best they could with the means at their disposal. Thus we see in one picture that very heavy reels of cable, weighing 17 tons apiece, are being loaded on flat cars for shipment to St. Louis by means of the railroad company's wrecking crane. This was a very simple means to employ and, until the demand for such cables becomes much more frequent than is likely for some time, it is much more economical than setting up specially purchased apparatus in the factory, which would only be used occasionally. The fact that only two of these reels could be placed safely on a single freight car will give an idea not only of their weight but also of the care which must be exercised in handling them.

Great Danger from Moisture

This great care in handling may seem rather unnecessary in view of the heavy armor and the generally heavy character of the cable; but, in common with many other carefully constructed objects, it is vulnerable in certain respects and cannot stand abuse. The great danger lies in the possibility of there being a hole in the lead sheathing which might permit the entrance of moisture and cause immediate breakdown of the insulation under the pressure of the 33,000 volts. A sharp bend is particularly liable to cause a crack in the lead which, in part, accounts for the large diameter of the reels on which the cables are shipped. The elaborate precautions taken

later, during the laying of the cable, to prevent unduly sharp bends and mechanical injury to the lead are all to this end.

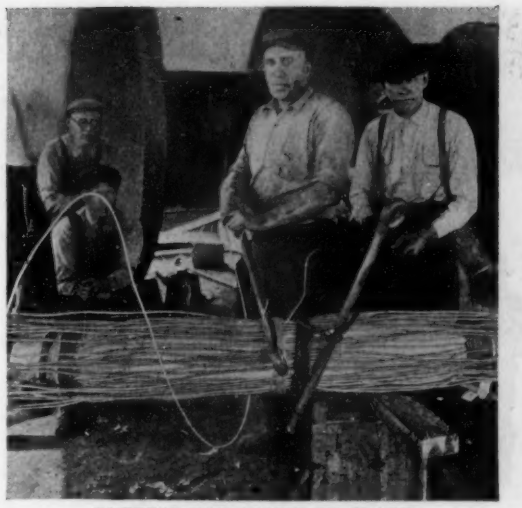
The reels of cable were sent to the Cahokia Power Station at East St. Louis, on the east side of the river, where they were unloaded from the freight cars by means of a traveling crane used for construction work on the power house and placed directly on barges. One of our illustrations shows the steel barge with reels set up so that they can turn on iron bars passed through the center for axles. One end of the cable is made fast at the power house and the barge containing the reels is then moved out into the river, the reels unwinding the cable as the barge progresses.

Cables Have to Be Anchored

It was necessary to lay the cable as closely along a predetermined route across the river as possible but, on account of the swiftness of the current and the slow speed at which the barge had to travel, this was no easy task. The most practicable way to accomplish this was to have several anchors in the river with ropes to the barge. By pulling on these ropes, which extended at various angles, by means of a donkey engine on the barge it was possible to pull the latter accurately in the desired direction. From time to time, as progress was made, some of the anchors had to be changed. This was done by a tugboat.

Another precaution, which had to be taken, peculiar to a river crossing of this kind, was to anchor the cables themselves so as to counteract their tendency to creep down stream, due to the force of the current. Stressing the cable beyond a limited amount would be dangerous to the insulation on account of the high voltage. Thus, in order to make doubly sure that no undue tension could be brought to bear by the current, the cable was laid in an arc bent against the direction of flow. Any tendency, therefore, to move with the current would produce slackness rather than tension.

We now come to the most delicate part of the whole operation—that of making the joints in the cable. Whereas it is a well established practice to make the single-conductor telegraph submarine cables of almost any length, a thousand miles or more, this is impossible with the three-conductor, lead-sheathed power cables. It is a question of manufacturing limitations, which it is not our purpose to discuss in this article.



PUTTING THE ARMOR IN PLACE

In matching up the ends for the joint, the cable was cut back under the armor wires, which were not cut. When the joint was completed, these armor wires were laid over the joint from each end and bound in place as shown

The fact remains that two sections of cable had to be joined together in the middle of the river and in such a way that the 33,000-volt current could not break through. It is a very different matter from that of making joints in the single conductor, gutta percha, insulated, non-leaded telegraph submarines where the outside pressure of the water at great depths tends to compress the slightly plastic insulation. Great care must be taken to avoid pin holes or any other imperfections which might permit the entrance of moisture. With these power cables there is the extra high voltage continually tending to break out from within, not only by virtue of its direct force but also by a gradual weakening process known as "ionization," whereby if air be present, the resisting property of the insulation may be slowly destroyed until a point is reached where the cable fails, perhaps with great violence because of the enormous capacity of the power house furnishing energy to it.

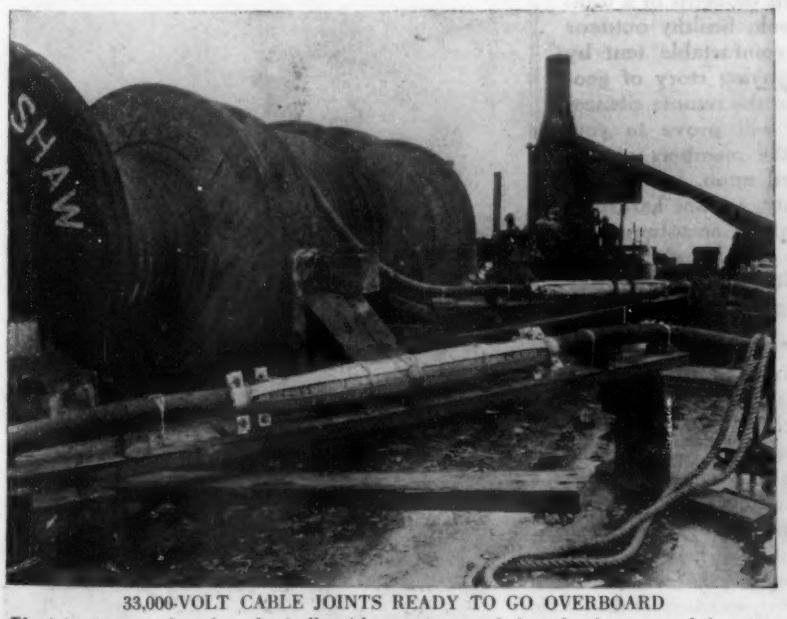
To make one of these "high-tension joints," as they are called, requires very careful workmanship, quite on a par with any of the skilled crafts. First, the armor and lead sheathing must be removed from the ends of the cables to be joined; next, the insulation from around the copper conductors must be removed so that they may be firmly connected together; after which the exposed copper must be covered again by winding tape around it by hand. This must be done carefully and evenly so as not to leave any "air pockets" or particles of dirt or metallic substances which would tend to weaken its insulating quality; for it must be remembered that 33,000 volts represents a powerful disrupting force which can only be confined within prescribed limits by closely obeying certain laws of nature, and the greater the force, or voltage, the less the margin of permissible deviation from these laws. For example, a certain piece of cable (not of this group) under high-voltage test in the factory was observed to develop a "hot spot." That is, during a short period, say five minutes, while the conductors had a high voltage impressed upon them the cable as a whole showed no abnormal reaction except for one isolated spot which began to heat up. If this had been allowed to continue the insulation would have become charred or "carbonized" and, carbon being a fairly good conductor, the cable would have broken down. As it was, the current was turned off and the insulation carefully stripped for examination, which disclosed the fact that the paper insulating tape had become wrinkled in some unaccountable way, with an air pocket as a result. This is exactly what has to be guarded against in making the joints, only it is more difficult when the work has to be done by hand in the open than in the factory and by machinery.

Hot Oil Boils Out Air

When the conductors are joined together, a lead sleeve of larger diameter than the original cable is slipped over the exposed insulation and soldered to the lead sheathing at each end. It is then filled with hot oil, which boils out all air and moisture from the texture of the insulation and fills up all vacant spaces. The hole through which the oil is poured is then sealed and the joint is completed electrically.

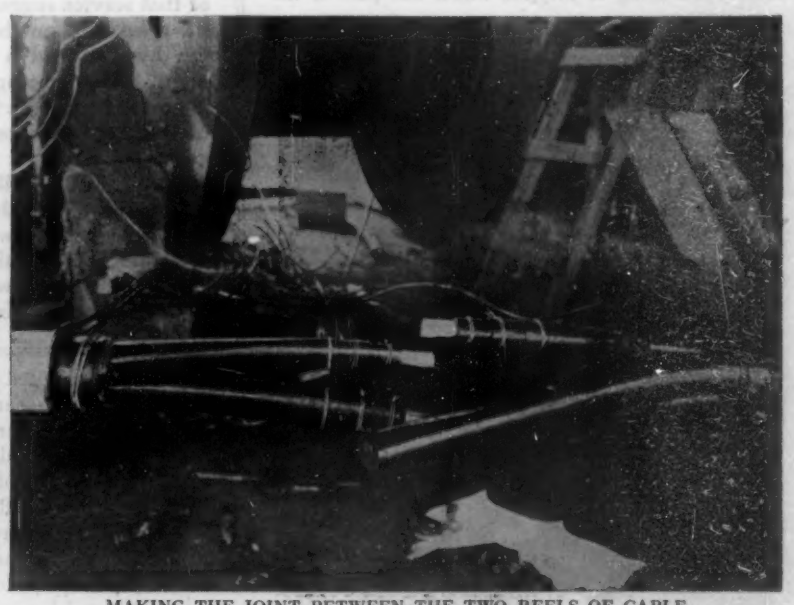
Mechanically it is not complete. The armor wires have to be put back in place and laid up around the lead sleeve covering the joint; and various precautions must be taken to stiffen the cable at this point to prevent the occurrence of sharp bends which might result in cracking the lead sheath.

The operation of making a joint as described takes a full day, during which time the cable barge must be anchored firmly to prevent its being worked downstream in the swift current.



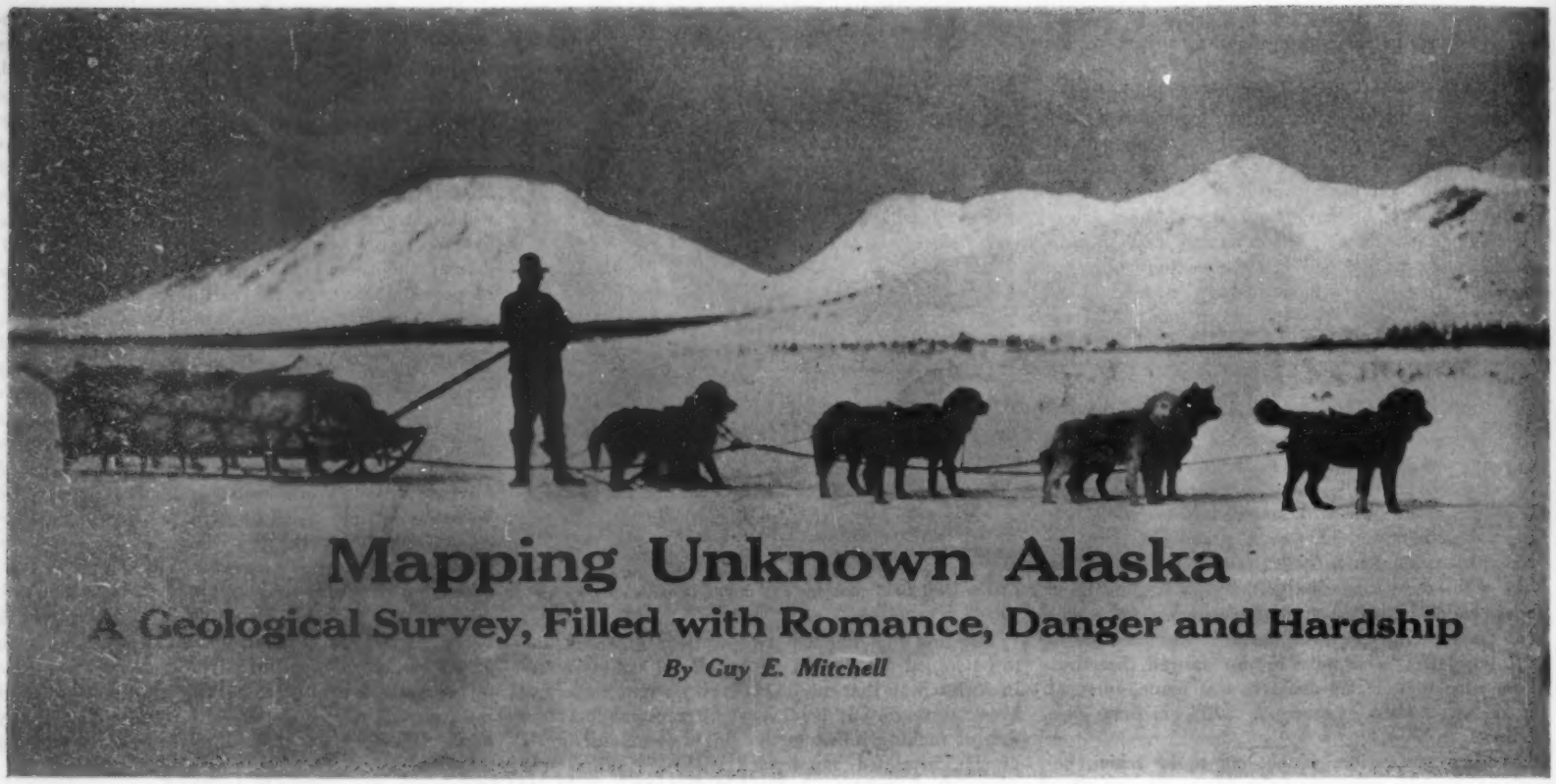
33,000-VOLT CABLE JOINTS READY TO GO OVERBOARD

The joint is strengthened mechanically with strap irons and sharp bends are guarded against by fastening the whole to a very heavy plank, by means of which it may be lifted into the water by a derrick without injury. This picture gives a good view of the donkey-engine whose principal function is to maneuver the barge by pulling on the anchor lines



MAKING THE JOINT BETWEEN THE TWO REELS OF CABLE

This operation is necessary for making the complete crossing. After the copper conductors are soldered together with the help of a copper sleeve, insulation is put on again by winding on tape by hand. A lead sleeve is then slipped over the joined conductors and soldered ("wiped") to the lead sheathing of the cable. This is filled with hot oil and sealed



Mapping Unknown Alaska

A Geological Survey, Filled with Romance, Danger and Hardship

By Guy E. Mitchell

THE last frontier of unknown Alaska has been penetrated with the exploration of some 7,000 square miles in the extreme northern reaches of the territory, the greater part of which had never been seen by a white man. This has just been accomplished by a Geological Survey expedition sent out last February to continue the exploration of Naval Petroleum Reserve Number 4 in Arctic Alaska. Gerald FitzGerald and Walter R. Smith, the topographic engineer and the geologist of the party, have returned after some seven months of work, during five months of which they did not see any human being except the other two members of their party and were entirely out of communication with the rest of the world. The other members of the party were Faye Delezeno and Walter R. Blankenship.

The official report of the trip is a simple narrative of the doing of the job, which was part of the routine duty of these men and to which they had been assigned because of their seasoned ability. But, through this apparently commonplace account, there runs an enthralling undercurrent of the adventure and romance that are inseparable from exploration in unknown and dangerous regions.

Everyday Heroism

The field of heroism is not confined to the battlefield or the broad expanses of the sea. It is to be found in many a sphere which the public mind little associates with those feats of courage, which win the greatly prized title of heroic. At the first thought, one would not associate heroic service with the United States Geological Survey. To most people, mention of that service suggests thoughts of a transit, a level, a notebook, healthy outdoor life by day and a comfortable tent by night. The accompanying story of geological survey work in the remote silences of northern Alaska will prove to you, gentle reader, that the members of this service may be called upon, in the performance of their duty, to face hardships and perils which we are accustomed to associate more with the search for the North Pole than with the day by day routine of engineering field work.

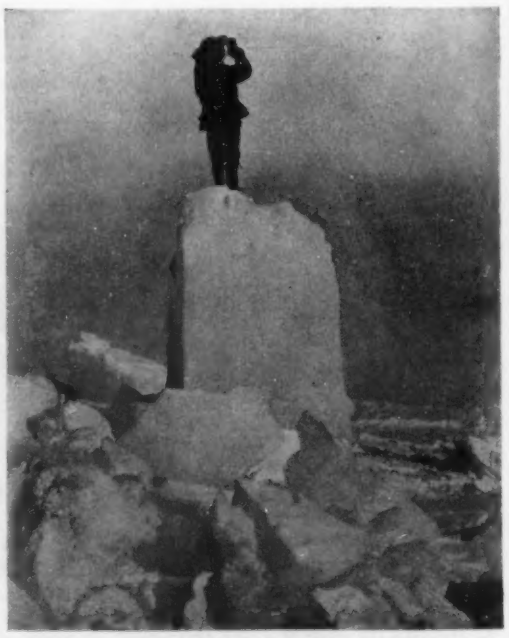
The expedition sailed from Seattle on February 28 and arrived at Nenana, the last outpost of the Alaska Railroad on March 10. On March 12 the party set out with two dog sleds, each loaded with 400 pounds of instruments and camp equipment, for the head of the Colville River, more than 1,000 miles away. The wilderness route led down the Tanana and Yukon rivers, overland to an Eskimo village on Bering Sea, northward along the coast, across Norton Sound and Seward Peninsula, and beyond the Arctic Circle to Kotzebue, where the party arrived on April 8. The distance of about 700 miles was done in twenty-six days of actual travel.

Over almost the entire distance one man ran behind each sled to guide it by handle bars. For these men there was no riding, wrapped in warm blankets or parkas, as you may perhaps picture Alaskan travel. Often it was necessary to go ahead of the dogs on snowshoes and break the trail which was obscured by heavy snows. The snow was four or five feet deep and where any one of the sledges missed the old, beaten trail by a few inches, it upset in the soft, deep snow. This usually resulted in a dog fight.

The arrival at Kotzebue ended the first stage of the journey, the greater part of it on the trail over which the diphtheria antitoxin had been raced to Nome a few months earlier. But with the Geological Survey party there was no race against death—to save the lives of men and women—nor other spectacular feature in which human interest figured prominently. What these men did, Geological Survey men have done in Alaska every season for years—their day's

ARCTIC STYLES

Artistry in dress is not confined to civilization



WHERE AM I?

Taking a "shot" with the sextant, just as at sea

FITZGERALD AND HIS "HUSKY"
Arctic dogs are like humans in their characteristics

work each day—and so, although every day actually thrilled with danger and adventure, these toughened scientist-explorers will hardly admit that anything that they encountered even approached an adventure.

When the party left Nenana the weather was warm and it had been raining. Before they left the Yukon it was thirty degrees below zero and a heavy snowstorm was encountered while they were crossing Norton Sound on April 1. The snow crusted on the eyes of the dogs and it was necessary for a man to go ahead of the team. At times it was impossible to see the lead dog from the sledges. When the party reached Koyuk, the Eskimo roadhouse keeper asked in amazement: "Where you come from? Didn't think anyone could travel through this storm."

Kotzebue marked the last roadhouse on the trip. Thereafter the party camped in tents, except one night at the native village of Noatak, which contains a population of 250, with neither a white man nor a half-breed, and not one of whom uses tobacco. The Eskimo drivers would not go farther than the head of the Utukok River, on the arctic slope, for fear that the snow would melt before they could return. As they turned back the little party of four white men was alone in the arctic snow-clad waste.

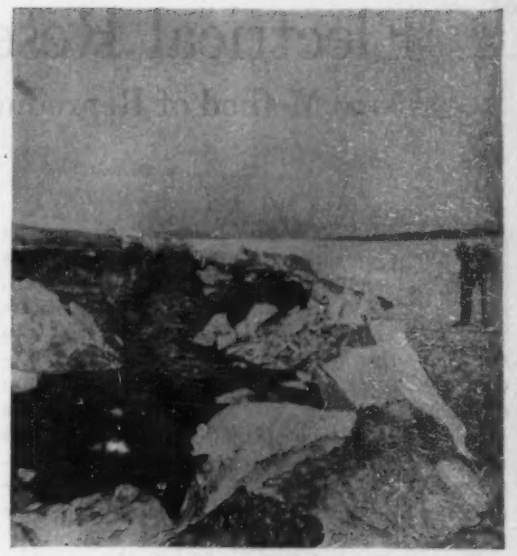
Topographic and geologic mapping was begun from earlier surveys on the south side of the Brooks Range and carried across to the headwaters of the Utukok River. As fast as the weather permitted, the supplies and a boat were relayed on toward the head of the Colville River. This river was partially explored the year previous, and a canoe which had been cached was picked up and brought overland to the Colville. Several times the river opened and froze again during heavy storms, but on May 30 the actual exploration of the upper Colville was begun.

Over white rapids and angry whirlpools and beneath undercut snowbanks the men paddled on, never knowing what would happen around the next bend, but realizing full well that if a boat should upset its contents could not be regained or replaced, and that if anyone were injured there were neither hospital nor physician within reach. Often the boats struck rocky bars and had to be lifted across. The dogs followed along the banks, but in trying to keep within sight of the boats they swam across the river many times each day. The party followed the river for more than a hundred miles and mapped an area from twenty to thirty miles wide on each side.

CARIBOU MEAT!
A most welcome feast after canned rations

In making the trips over the rough tundra away from the river, the dogs were used as pack animals, carrying packs of from twenty-five to thirty pounds for distances of eighteen to twenty-eight miles a day. Over the shorter portages some of the dogs carried burdens of forty pounds. Snowstorms were frequent, but the snow did not remain on the tundra. By the middle of June the hills were dotted with flowers.

Formerly the Eskimos lived along the banks of the Colville. Their old igloos, pieces of clay pottery, and broken bone implements were found. At one point in this northern country a giant leg bone of a mammoth was found. The Eskimos are stated to have migrated to the coast many years ago in order to be nearer the traders. Parts of the interior northland are, as a matter of fact, unknown to the Eskimos.



A CREVASSE IN A GLACIER
One of the many dangers which the surveyor faces

By July 13 the mapping work was tied in to a previous survey of the central part of the Colville Valley, and the party turned south to the Etivluk River, a large tributary of the Colville. This river was ascended about 80 miles to its source, at the summit of a pass in the heart of the Brooks Range.*

The Etivluk is a swift, turbulent river, flowing over many rapids and bars. The dogs again proved very useful in lining the boats; but many times a day for fifteen days all the men waded in swift ice water above the waist, to get the boats across the rapids.

A low pass was found at the head of the Etivluk and a portage of less than one mile put the explorers on the head waters of the Aniuk River, tributary of the Noatak River. The party descended the Aniuk about fifty miles and closed the new surveys by connecting in to the earlier surveys of the Noatak. The return trip was made down the Noatak to Kotzebue, thence to Nome and Seattle, where the party arrived on September 16.

*Formerly the Arctic Range, but renamed "Brooks Range" after the late Dr. A. H. Brooks, of the U. S. Geological Survey.

ROUGH GOING
In the arctic, the endurance of both men and dogs is tested to the utmost

AN OVER-NIGHT CAMP
The dogs are tied out in the open. They prefer it to being under cover

Electrical Research Applied to the Phonograph

A New Method of Reproduction Brings a Sense of Realism to Phonographic Presentation

By Joseph P. Maxfield
Bell Telephone Laboratories, Inc.

A SUCCESSFUL solution of the problem of phonograph reproduction requires an alliance between science and art. Most entertainment of a musical nature has involved heretofore at least two senses—hearing and sight, while phonograph reproduction and, for that matter, any mechanical form of musical production involves hearing only. It is insufficient to reproduce faithfully the audible part only of an artistically successful musical performance and it is necessary in some way to simulate the so-called "atmosphere" or contact between the artist and the audience.

There are several factors which tend to produce the sense of reality and the illusion of the presence

HENRY C. HARRISON
He exhibits an opened up model of the new phonograph, of many of whose principles he is the inventor

of the artist. The most important of these is control of the acoustics of the room or hall in which the record is made. It has been shown by Sabine that studios used for piano music should have a time of reverberation measured by his method of 1.08 seconds. Our experience has indicated that this figure is very closely correct for other types of music. This figure of Sabine's assumes two ear listening, that is, binaural listening. With a "one ear" system such as radio transmission or phonographic reproduction, the ability of the listener to separate the reverberation from the direct music by means of the sense of direction is completely removed and the listener has thrust upon his attention an apparently excessive amount of room echo. Experience has shown that a time of reverberation ranging from slightly more than one-half to slightly less than three-fourths of the Sabine figure simulates in the reproduced music the effect of a room with proper acoustics. When this effect is properly produced, the person listening to the reproduced music is conscious of the fact that the music is being played in a continuation of the room in which he is listening and a sense of spacial depth, nearness to the artist, is created.

Another important factor is the ability to reproduce the weaker sounds made during the act of performing music. Since many of these sounds, such as the sibilants in speech, the intake of breath of the singer, and the touch of the bow of a stringed instrument are carried mainly by the higher frequencies, this portion of the musical range becomes important in this connection and is very important to the proper rendering of the tone quality of the various instruments. When these higher harmonics are not present in the reproduced music, the impression is created that the performance is being carried on behind some sort of heavy curtain or screen and the characteristic tones of such instruments as the violin, oboe and brasses are considerably distorted.

Similarly, very few musical selections can be rendered in such a manner as to produce the effect of the artists being in the room with the listener—that is, the necessary sense of intimacy—unless they possess power or body in the heavy low toned notes. This requires that the reproduction shall include the low notes of the musical scale.

Intensely Sensitive Reproducer

In this connection, the fact should be made very clear that a reproducing system which fails to reproduce all frequencies below, let us say, 300 cycles per second, will, nevertheless, reproduce the auditory sensation of a musical note whose fundamental is below 300 cycles even though the fundamental and one or two of its harmonics have been eliminated in the reproduction. While this elimination of the lower frequencies in no way changes the pitch of the note, it does change what is commonly called the "character" or "timbre" of the tone. The change in the quality is such that the note seems to lose the heavy body in the low frequencies and becomes a rather thin metallic type of note. The quality of tone characteristic of the older type of talking machine was largely brought about by the failure to reproduce these lower tones.

This leads naturally to the most important part of the scientific work which it was necessary to complete in order to solve even approximately the problem of satisfactory phonograph reproduction. In its broadest sense, this part of the problem may be stated as that of taking sound from the air, storing it in some permanent way and releasing it again without appreciable change. It is immaterial from a general standpoint whether the means used are mechanical, electrical or a combination of the two. The choice of which method to use will depend largely upon the commercial factors surrounding the specific purpose for which the reproduction is being made. For instance, it is quite probable that the means chosen for reproduction in the home could differ materially from those used in a large hotel ballroom or in connection with synchronized motion pictures.

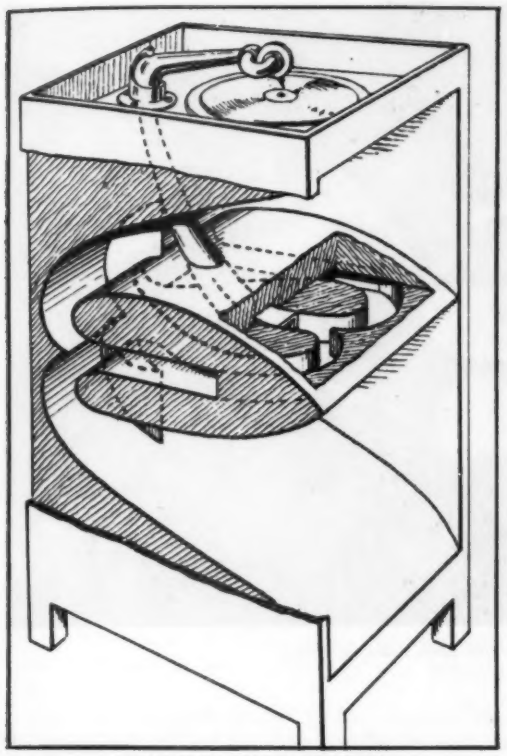
THE AUTHOR
Joseph P. Maxfield is examining a reduced-scale model of the new type horn

Courtesy of Victor Talking Machine Co.
LUCREZIA BORI
Hears her voice on the new phonograph. It is a more perfect reproduction than artists have secured in the past

Where the machine is to be used for reproduction in the home, it has been found that the energy which can be taken from the record is more than sufficient to give a volume even exceeding that required for a large living room. It therefore appeared unwise to introduce an unnecessary electrical link between the mechanical system which is operated by the record and that which must be used to radiate sound into the air.

The history of the development of nearly all of the technical arts has shown that from time to time the progress of the art has received an impetus through the adoption of some new principle. In the periods between these advances take place the improvements in details which result in the new principle being applied to the best commercial advantage.

This has been so in the talking machine art. Early in its development, the introduction of a duplicating process by means of which large numbers of records on long wearing material could be made from a first impression on soft wax, allowed the talking machine field to be exploited commercially. Then the development of a smooth running spring-driven machine in place of the early hand-operated ones opened up a field of higher class music.



PHANTOM CROSS SECTION

Of the acoustic passages, showing their convolutions and gradual enlargement in two planes

The method of reproduction which will be described represents the outcome of the application of new principles to the talking machine art. These new principles have been largely borrowed from the results of research on telephone circuits. Mechanical analogies for electric circuits have been used in the teaching of electricity for some years. Moreover, in the field of application, particularly in the art of communication problems of wave transmission in electric circuits have been very completely worked out by Campbell, Zobel and others.

When a survey of the talking machine problem was made, it was early realized that most of the problems were of a wave transmission character in mechanical systems and the work was greatly aided by reversing the use of the analogies between the mechanical and the electric circuits to give us explanations of the behavior of mechanical systems in terms of known electric systems.

By designing the acoustic transmission system as the analogy of the proper electrical system, vibrations up to five thousand cycles per second can be passed through. This has been done in the new talking machine and as a result, the higher overtones of speech and music are reproduced, provided, of course, that they are present in the grooves of the record. The radical improvement in the reproduction has been obtained, not only by improving the reproducing machine but also by improving the record to cover the requirements mentioned.

Turning to the region of the low tones, transmission theory shows that here again there is a cut-off point for the acoustic transmission system determining the deepest notes which can be given out. There is a definite relation between the rate of taper of the horn and the size of the opening of its large end for a predetermined low limit of tone. In the new talking machine a much larger horn than those used in the past has been incorporated and has been designed to fit into a cabinet of commercial size. The horn is folded on itself and by making the bends at places where the sound path is narrow it has been possible to effect this folding and still maintain the correct design.

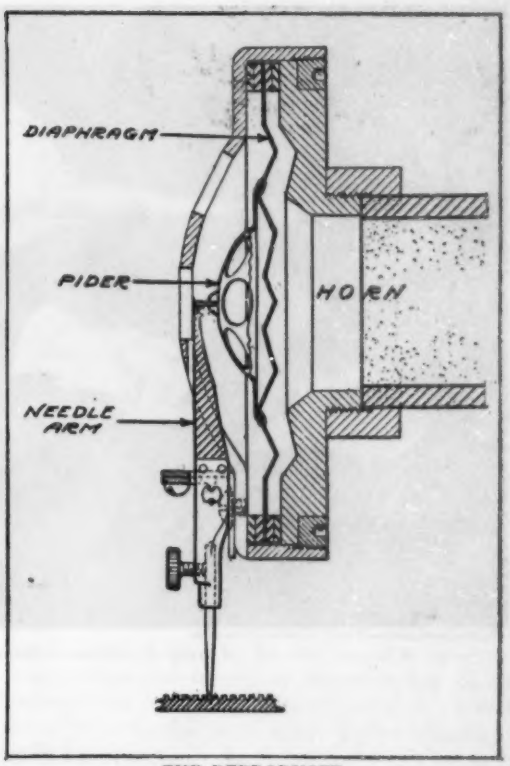
When this horn is so designed that the mouth opening is large enough to radiate all notes which reach it, there is obviously no reflection at the mouth and hence no fundamental resonance of the horn. Since the rate at which the horn tapers or flares determines the lowest note or frequency which reaches the mouth, it is seen that such a horn can easily be designed.

Harmonics Reproduced in Wide Range

The improvements which have resulted from the new method of recording and the newly designed talking machine are quite marked. There are three important ones. First, and most striking, is the reproduction of the bass and the higher harmonics. The reproduction of the bass, that is, the lower frequencies, adds the "body and weight" to the music which has been missing in the past, while the reproduction of the higher harmonics introduces a definition or detail which has also been lacking. This improvement in definition coupled with the rendering of the lower notes has made possible the reproduction of very large orchestras and choruses which has heretofore been almost impossible. As mentioned previously, it has also produced the illusion that the artist whose record is being listened to is right out in the room with the listener.

The second big improvement is the addition of the "atmosphere" surrounding the music, that is, the sense which the listener has that the music has been played in a room or a hall.

The third improvement relates to the apparent loudness. Although the new machine gives one a sense of being louder than the old types, it never irritates the ear as was the case with many of the old reproductions. This is because the apparent increased loudness has been obtained by adding notes which were not reproduced at all or at least very poorly in the older machines, and not by making those notes, which were reproduced well before, louder than they were. In fact the notes which were reproduced most loudly on the old machines are not as loud on the new machine as they were on the old.

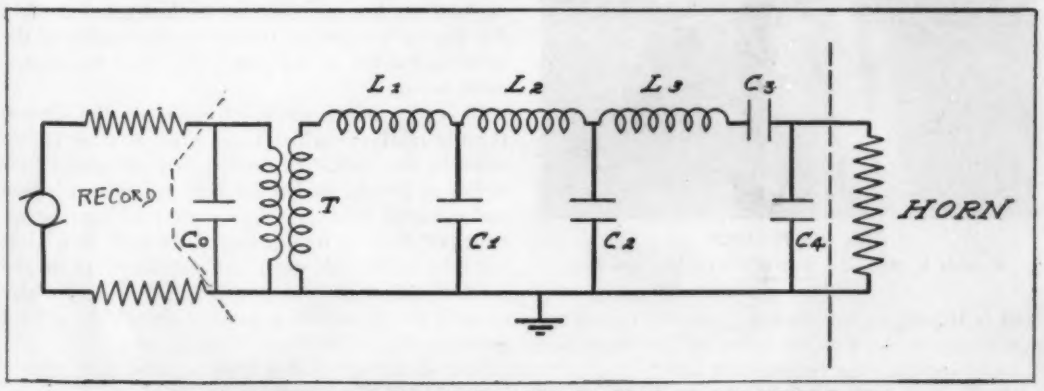


THE REPRODUCER

The corrugated diaphragm and the fingered spider that bears thereon register the sound vibrations

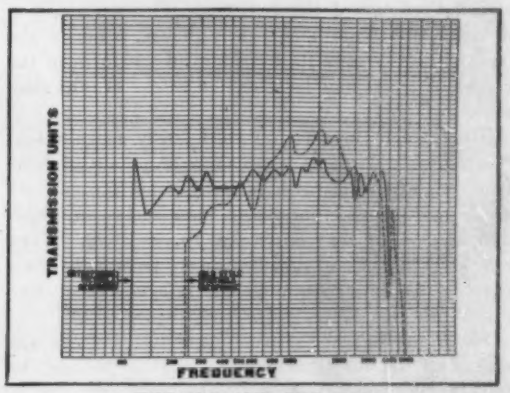
It is important to remember that while this new machine is a considerable improvement over the older type, this improvement could not be completely utilized if new methods of recording had not been developed also. The new methods of recording employ high quality "pick-up" apparatus, distortionless vacuum tube amplifiers and an electromagnetic means for driving the stylus which cuts the original record. The result of this new process of recording has been two-fold—first, notes ranging from the low bass up to the higher harmonics have been recorded; second, the acoustic effects of the studio which produce the so-called "atmosphere" surrounding the music have also been recorded, in the graded manner previously noted.

When all of these results have been accomplished in the artificial reproduction of music and speech, the listener seems to "feel" the presence of the artists to whose record he is listening. There is a noticeable depth and carrying quality, not previously appreciable. To complete the illusion, it would be necessary for the listener to see as well as hear the artists. While this latter requirement has not been fulfilled in any way, the illusion produced is so good that the reproduction is raised from the class of minor amusement to that of an artistic production. Telavision promises to complete the illusion.



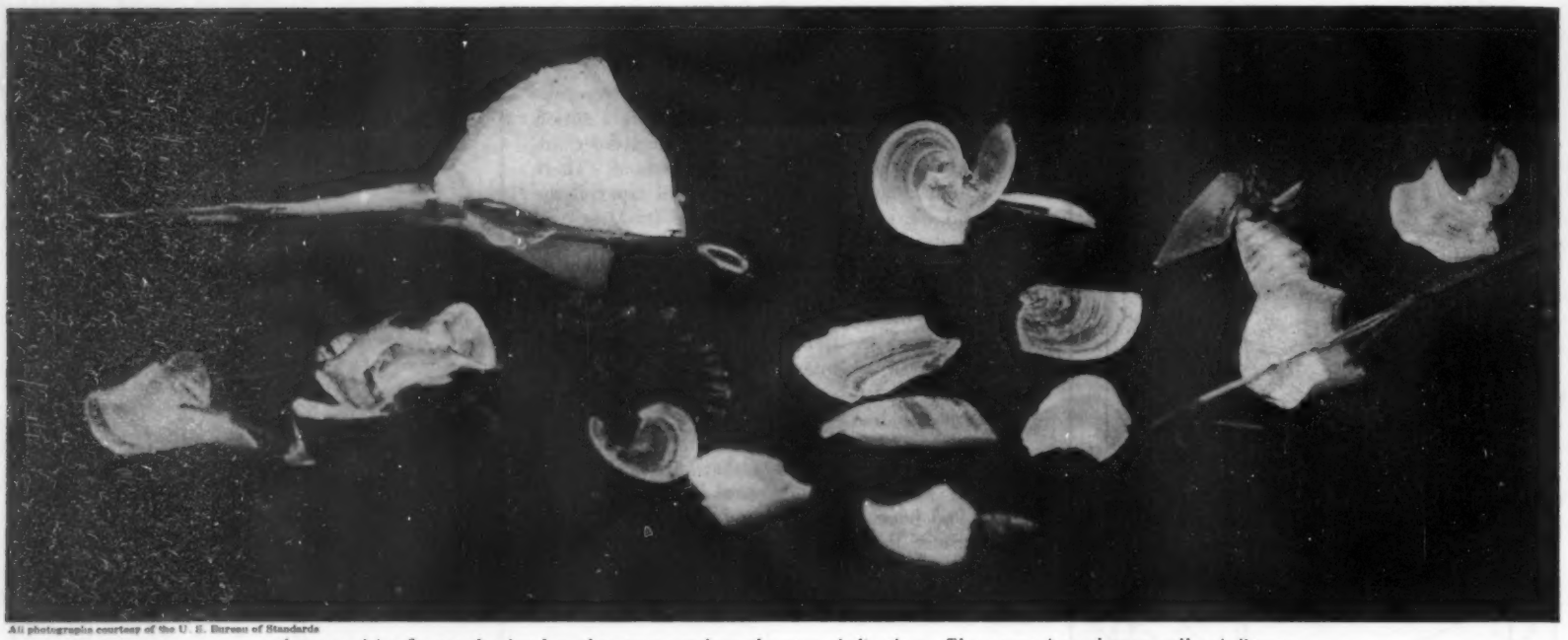
A TRANSFORMER OF RATIO EQUIVALENT TO THAT OF THE NEEDLE ARM

Coil L1 represents the effective mass of the needle arm; C, flexibility of arm tip; L2, mass of spider; C2, flexibility of spider legs; L3, mass diaphragm; C3, flexibility of diaphragm edge; C4 compressibility of air between diaphragm and back-plate



THE OLD AND THE NEW

These curves show the comparative loudness of the old and new types of phonograph over the frequency range



All photographs courtesy of the U. S. Bureau of Standards

A group of ice flowers showing how they grow out from the stem of the plant. These were formed upon stalks of dittany

Ice Flowers

Phantom-like Blossoms Appear at the Roots of Plants and Disappear with the Morning Sun

By Nell Ray Clarke

SOME of the wild flower families are not satisfied with doing their bit to make the world beautiful during the spring and summer. When Jack Frost begins turning the leaves brown, these plants bloom again down near their roots in queer white blossoms.

The blossoms are phantom-like; now they are visible and then they disappear. Sometimes they are tied with satiny white ribbons like a bridal bouquet. In the morning they are at their best; but when the sun peeps over the horizon's rim, they fade away before your very eyes. The slug-abed and the victim of apartment house life and paved streets never sees them and seldom knows they exist; but the rambler over field and wayside, who loves the crunch of frost beneath his feet, is familiar with them. Sometimes he calls them by such an unromantic name as "ground ice"; sometimes they are called "frost flowers," or "ice fringes."

They Bloom on Frosty Mornings

Many of our annual plants with perennial roots "bloom" in this manner during the fall. The thistle and the stumps of the heliotrope, "rock mint," or dittany, flea bane and other plants produce the flowers. Sometimes these fringes of ice form in the cracks of trees, and between the bricks of old sidewalks.

They are to be seen on cold frosty mornings in November to January when there is plenty of hoar frost but when the earth beneath is not frozen. As a rule they range from one to three inches in length and sometimes they grow six inches long. They assume complex and sometimes very beautiful forms, varying enough to stimulate the imagination to find names for them.

Sir John Herschel nearly one hundred years ago described the ice flower as a "kind of riband, or frill-shaped, wavy, friable semipellucid excrescence, the structure of which is 'fibrous,' like the fibrous variety of gypsum, presenting a glassy, silky, wavy surface; the direction of the fibers being at right angles to the stem, or horizontal."

For some time early-rising scientists argued among themselves as to the real cause of these ice flowers; and several of them held for years that they were formed on the outside of the plant stem just as

AN ICE FLOWER

A thing of graceful beauty which vanishes quickly

frost is formed on the window pane—by the formation of ice spicules as the result of the deposition of moisture from the surrounding air.

Dr. W. W. Coblentz, physicist of the United States Bureau of Standards, who for years has been watching the frost flowers which form on plants in Rock Creek Park in Washington, has another theory concerning their origin. He has also made detailed experiments to support his belief that the water for the ice flowers comes from the plant itself.

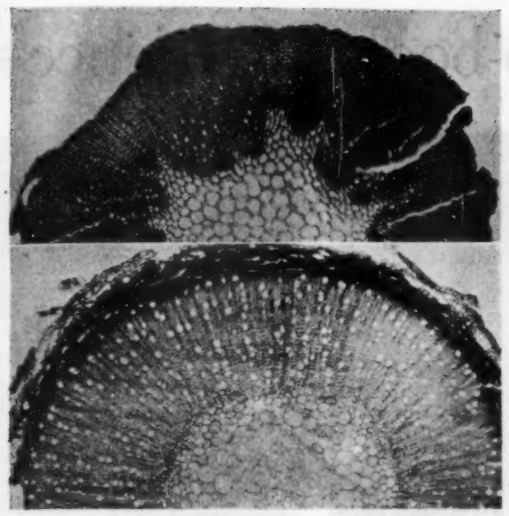
Botany wasn't especially in his line; but he first became interested in ice fringes when he noticed beside the road what at first looked like a rosette of white satin ribbon which might have been thrown there from some passing automobile or carriage. Then he noticed that the white fibrous loops and ribbons were fastened firmly upon a dry twig and that they were made of ice. So he bundled the specimen up and sent it to one of the professors at the United States Weather Bureau. The professor was interested and suggested that Dr. Coblentz make a study of such ice formations.

Dr. Coblentz' Experiments

Before beginning work Dr. Coblentz looked up the matter and found that John Le Conte, while studying plant life in the lowlands of South Carolina and Georgia, had noticed such fringes and had expressed himself as believing that they came from the pith of the plant. Dr. Coblentz did not accept Le Conte's explanation, however, because he had noted the fact that the ice was always formed on the outside of the stems and never on the pith. And then his experiments began.

He cut a bunch of dried stems of the dittany (Cunila mariana) which has a great number of sap tubes in the stalk. He broke them off about four inches in length, peeled the bark off some of them and mounted them in a heavy piece of pasteboard, cemented them in tight, inserted the ends in a glass test tube filled with water and put them out on the window sill on a cold frosty night. He carefully covered the stems with a glass receptacle to prevent the deposition of moisture from the air.

One of the stems had been painted over with a cement which is impervious to water, to keep the water from being drawn up through the sap tubes. It was significant that this stem formed no fringes.



CROSS SECTIONS OF STEMS

Above: An aster. It has a compact woody structure and few sap tubes. Below: Heliotrope. Note the numerous sap tubes through which water reaches the surface

On the other hand, the stems which had their lower ends immersed in the water did form beautiful fringes.

This was conclusive proof to Dr. Coblentz that ice flowers are formed by water passing through the stems of the plants and freezing on the outside, or as he puts it, by "capillary action." He argued that the water for the ice fringes upon growing plants comes from the sap, though the solid contents of the sap which give it its taste or color do not reach the surface, for the ice is tasteless in spite of the fact that dittany, or "rock mint," has a strong fragrance of thymol.

"The amount of ice formed upon a plant stem," said Dr. Coblentz, "is dependent upon the rate at which the water can rise by capillary action in the sap tubes within the stem, the ease with which the moisture can pass out to the surface, the rate of evaporation from the surface (dependent upon the wind and other factors), and the texture of the surface of the stem—whether it gives out the sap freely."

For the average individual the question would have been settled with the first experiment, but not for Dr. Coblentz. He clung to his theory that the water traveled up the sap tubes; but in order to prove that it didn't creep up along the cambium layer of the plant, or the bark as we would say, he made a few more experiments with his test tube.

He took several dried stems of the dittany and covered them with shellac and he found that they formed no fringes—again conclusive evidence that the water for fringes had to come from within the plant. The shellac had prevented its coming to the surface.

Next he took some more dried stems and fixed them in a test tube as before, but he cemented their sides over with a substance which would keep any moisture from creeping up on the outside of the stems or along the bark. To make assurance doubly sure he put some red dye in the water in the test tube. Next morning the red dye was creeping out at the top of the stems, showing conclusively that it had made its way during the night through the entire length of the stems *by way of the sap tubes;* for the sides of the stems had been cemented over and it was therefore impossible for the water to rise in any other way.

Another proof of his contention was that in each case considerable water had disappeared from the test tube. The glass beakers covering the stems were perfectly clean, showing that no water vapor had condensed upon them. Evidently the ice fringes had been formed from the water that had disappeared from the test tube.

Moisture Flows Through Sap Tubes

"One of my most interesting observations in this experimental work," said Dr. Coblentz, "was the formation of the ice fringe from its very beginning. This was also watched by several of my colleagues in order that they might verify my observations. We placed some of the stems mounted in cardboard with their ends immersed in water on the window sill one cold morning. In about 20 minutes, the ice began forming. It consisted of a row of fine hairs extending up and down a length of about four millimeters of the stem and projecting horizontally. They were visible only when viewed against skylight and they melted immediately when the glass cover was lifted.

"The fringe did not appear to form at the line where the pith is closest to the surface of the stem.

"Within half an hour after placing the specimens in the cold air one stem showed several fringes in the form of thin transparent 'teeth,' each one being about 12 millimeters in length. Another stem showed a fine hairy fringe which was visible when viewed against gaslight. Within half an hour this hairy fringe appeared to be solid, with some of the fine hairs extending horizontally outward through the

WHERE ICE FRINGE FORMS

Here is a bunch of dittany or "rock mint," a small perennial American herb. From November to January this plant produces beautiful ice flowers down near its roots

solid 'tooth' of ice. By the next morning numerous wide fringes had formed on the stems, and in one instance had pushed out a narrow strip of the bark away from the stem, a thing which often happens in such formations.

"It was obvious that the fringe forms some distance up the stem, at a point where it cools quickest and where the moisture has risen to about its maximum height.

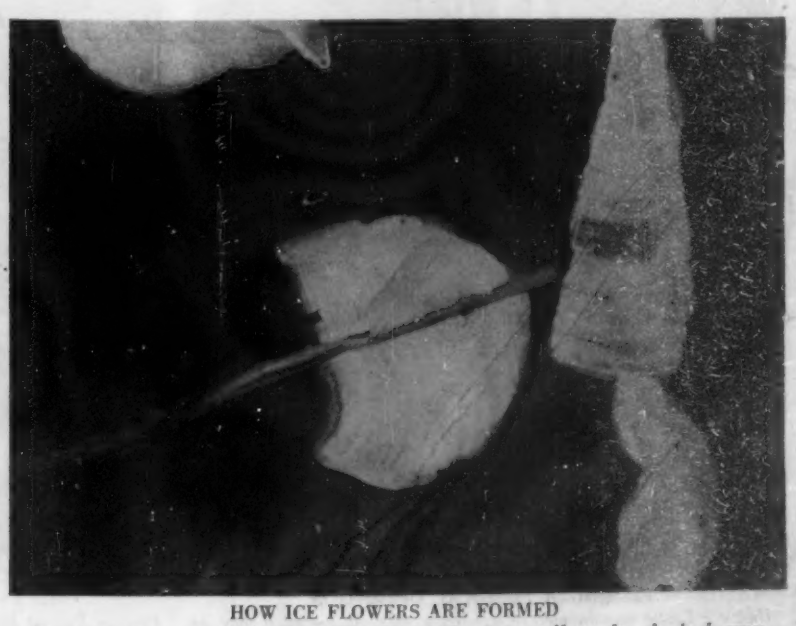
"We also discovered from later experiments that at no time did ice form on the pith, and that the ice fringe did not always start at the 'corner' of the stem where the wood is the thickest, nor did it start at that part of the stem where the wood is thinnest, but at the point where the sap tubes lie nearest the surface—where the moisture can be most easily supplied.

"Ice flowers will also form on pieces of unglazed pottery, like the ordinary red clay flower pot, when it is found lying upon wet soil. I have observed in several instances a column of ice an inch high upon such fragments.

"The location and the amount of the ice formation is evidently determined by the ease with which the moisture can be supplied from within the plant, and it seldom forms when the ground is frozen solid, or when there is much wind which would cause rapid evaporation from the surface of the stem."

ETHEREAL, PHANTOM-LIKE BLOSSOMS

A group of ice flowers similar to this one may be seen in the woods or in a city park



HOW ICE FLOWERS ARE FORMED

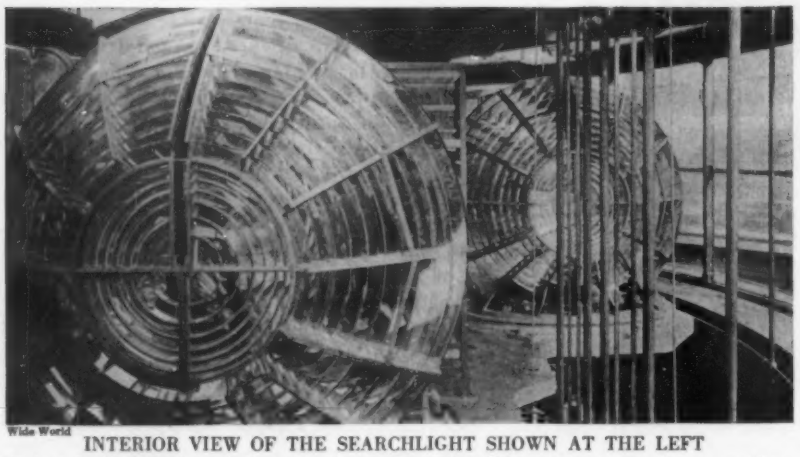
The water in the sap, forcing its way to the outside of the stalk, pushes the bark away

From the Scrap-book of Science—Cam

Wide World

SEARCHLIGHT VISIBLE 300 MILES

In France a great airplane-guiding beacon whose beams will be visible as far as southern England and northern Italy has been installed



Wide World

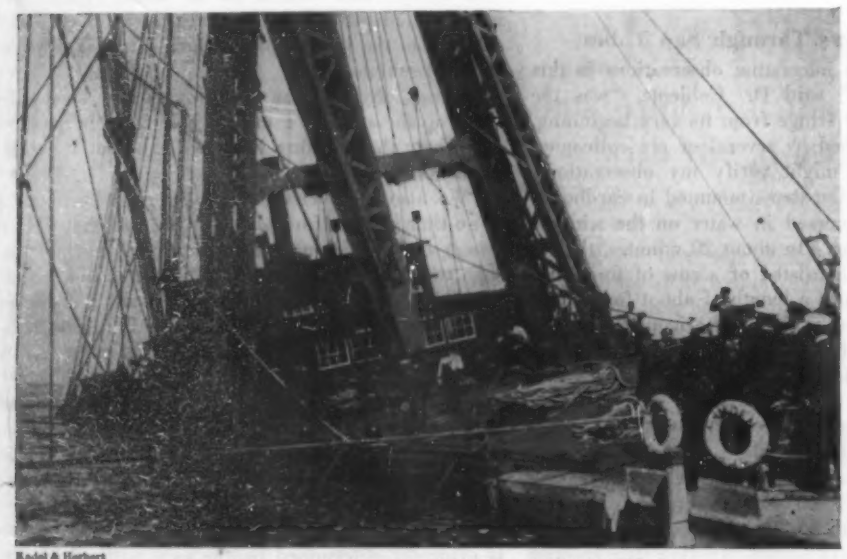
INTERIOR VIEW OF THE SEARCHLIGHT SHOWN AT THE LEFT

During the World War, airplane squadrons sent on bombing missions over the enemy lines often went astray while attempting to return in the dark. France built a mammoth beacon, visible for hundreds of miles. Today it is used to guide peacetime aviators

Wide World

IMPORTANT WORK OF THE BUREA

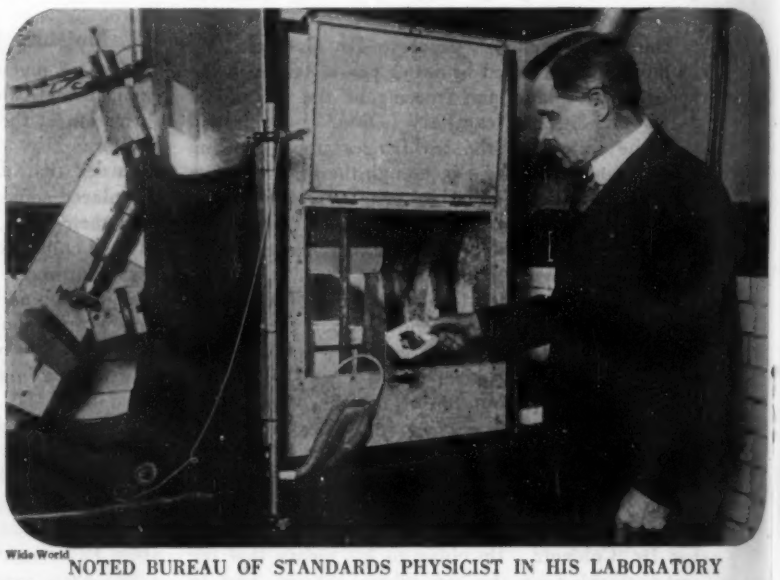
When the physician makes a blood count in order to diag divided into chambers. To check up, in turn, on the acc Standards has perfected an instrument



Kadel & Herbert

STRAINING TO RAISE THE SUNKEN SUBMARINE *S-51*

Shortly after the S-51 sank off the coast of Rhode Island, two heavy floating derricks were made fast to the damaged submarine. Although both vessels lifted every ounce their stability permitted, the water-filled submarine was not moved. The Monarch *is here lifting 250 tons*



Wide World

NOTED BUREAU OF STANDARDS PHYSICIST IN HIS LABORATORY

Although this picture shows Dr. W. W. Coblentz killing germs with ultra-violet rays, his recent measurements of the temperature on Mars, in which daytime temperatures of 45 to 65 degrees Fahrenheit were found, is the work for which the public knows him best

Wide World

FILMING A SURGICAL OPERATION

Under a Berlin motion picture camera, a surgical operation may be filmed, so that medical students may witness the operation later

Wide World

TO TAKE "MOVIES" OF SUN'S ECLIPSE

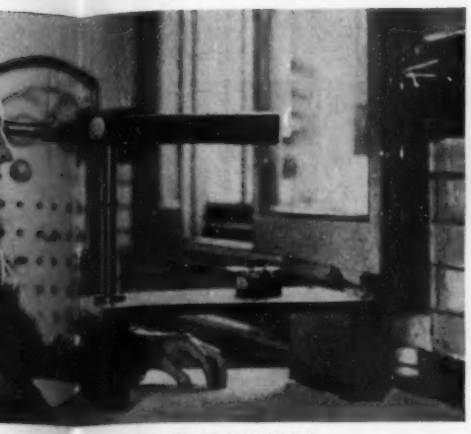
Captain Barnett Harris, U. S. R., of the Harvard Eclipse Expedition will take motion pictures of the total eclipse in Sumatra, January 14th

Pictograms

BLOOD TRANSFU

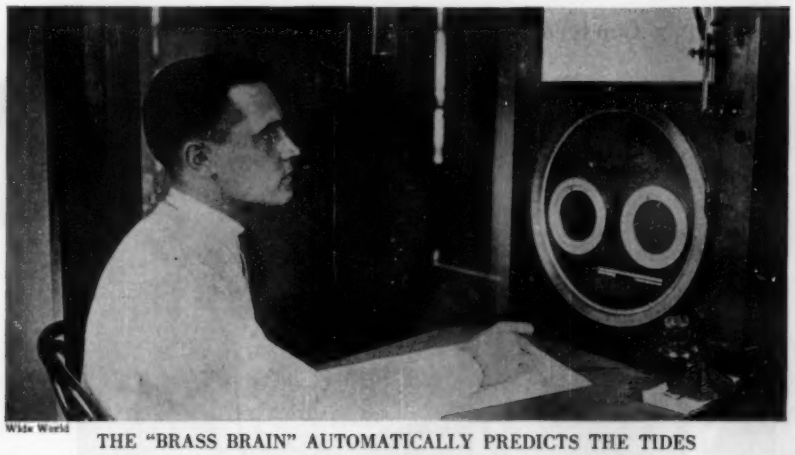
A motor operates the syringe which aids the heart of the donor of of the patient. This new apparatus was invented by

—Camera Shots of Scientific Happenings



ORK OF THE BUREAU OF STANDARDS

count in order to diagnose your case, he uses a small device p, in turn, on the accuracy of these devices, the Bureau of perfected an instrument of great precision



Wide World

THE "BRASS BRAIN" AUTOMATICALLY PREDICTS THE TIDES

In the laboratory of the Coast and Geodetic Survey, at Washington, there is a remarkable scientific instrument which predicts the time of ebb and flow of the tides in any seaport of the world. Automatically, it does the work of sixty mathematicians

Wide World

THE LARGEST CAMERA EVER BUILT?

The giant "still" camera, pictured above, which has a lens about two feet in diameter, was recently displayed at an exhibition in Berlin

RY

his recent 65 degrees

Wide World

CAN A GIRL BEND A FOUR-INCH STEEL SHAFT?

At the Bureau of Standards in Washington, D. C., there is a short piece of steel shafting, mounted on two end supports. Even the pressure of a fingertip bends the bar a few millionths of an inch, and the interferometer accurately indicates the result

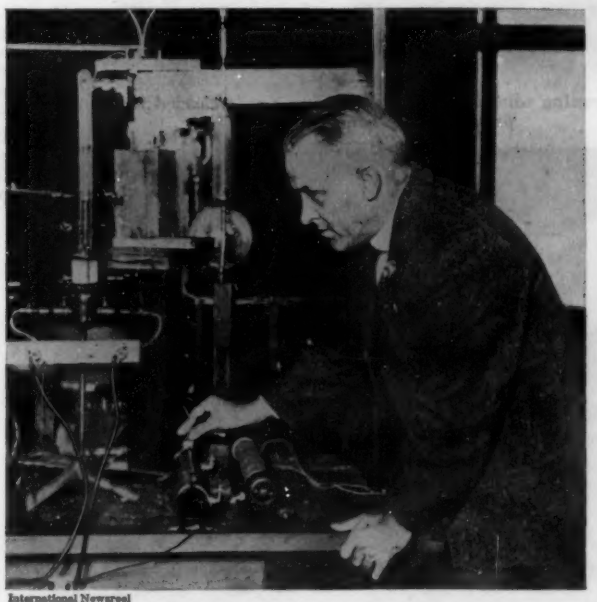
International Newsreel

A MODERN MINE RESCUE TEAM READY FOR ACTION

Here is a mine rescue team in Pennsylvania, ready to enter any mine where fire, cave-in or explosion has entombed the miners. Three of the members wear gas masks; the rest wear more special breathing apparatus. All carry the most modern safety lamps

ANSFUSION BY ELECTRIC POWER

the heart of the donor of blood to pump blood into the blood vessels apparatus invented by Dr. A. L. Soresi, of Brooklyn



International Newsreel

AMERICAN PHYSICIST FINDS NEW RAY

Dr. R. A. Millikan, who won the Nobel Prize for weighing the electron, has found a new ray of 10,000,000 times the frequency of light

International Newsreel

AIR-RAID DAMAGE JUST REVEALED

"Now it can be told," is the admission of the British Government which has just released photographs showing Zeppelin damage in London

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts

Conducted by Albert A. Hopkins

Untangling the telephone cord

Makes a Kinkless Telephone Cord

DOES your telephone cord kink? On this page we show a simple method of rendering it kink-proof. A series of wire loops constitute a device which is attached to the cord by means of pliers or even a coin. With it applied, you can always pull the cord out full length, but it will always snap back when you put the telephone down.

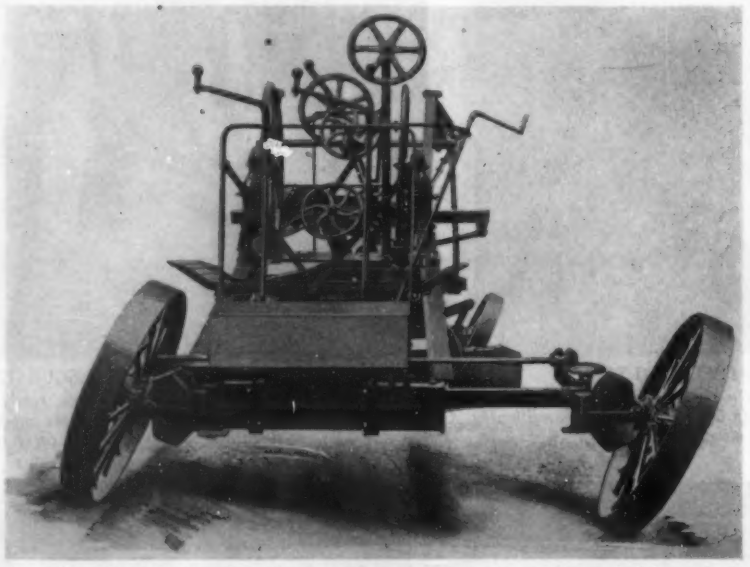
A Shop from the "Five and Ten" Cent Store

WE show here a pretty good-looking and an exceedingly useful shop. Every article came directly from a five and ten cent store. It is not claimed that every article can be bought in every "five and ten"—far from it. The tools came from shops bearing five different names. These stores vary their stocks right in the same city. For example, the writer went to a well-known store near his home and secured about six or seven tools, yet one of the same name near the Woolworth Building would have produced thirty or more tools. The cost of all these tools was exactly five dollars; and the extra supplies cost about two dollars more. The vise for ten cents is a real wonder, and the tap and holder for twenty cents is a rare bargain. A shop like this can be installed in any house after a few visits to our fixed priced stores.

A Twine Cutter Worn Like a Ring

THE new twine cutter illustrated on this page may be worn on the finger even when the user puts his hands in his pocket. The blade can be sharpened when it becomes dull, or a new blade can be put in by driving out the holding pin. This latter operation is accomplished by loosening the flat spring with a screwdriver, and turning the blade to the left.

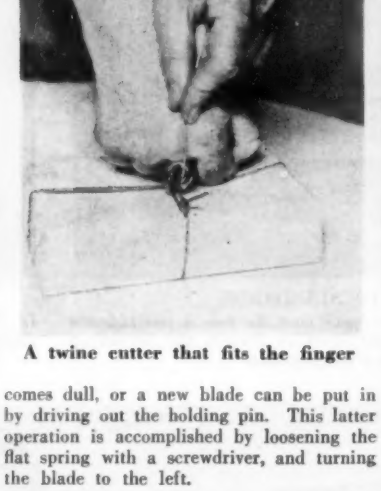
What $5 will buy in the five and ten cent stores



A road grader with leaning wheels and a telescopic rear axle carried in a dust-proof steel housing

A hand power kitchen "slavey"

First aid to the draughtsman



A twine cutter that fits the finger

A Novel Road Grader

THE outstanding feature of the new grader, shown on this page, with leaning wheels, is the telescopic rear axle. Separate cranks near the operator control the right hand and the left hand extensions. The axle is carried in a dust-proof steel housing in which the gears controlling the telescopic movement run in oil.

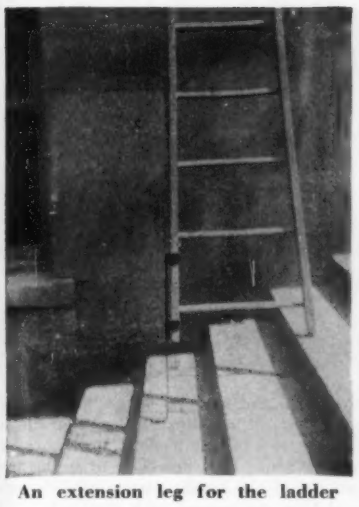
A Mechanical Assistant for the Kitchen

WE show here a hand power combination machine for saving time in numerous household tasks which will whip cream, extract fruit juice, beat eggs, and even sharpen knives. There is said to be no splashing or spilling of the contents. Its work is done by means of a number of attachments, which may be changed in a very few minutes. It can be attached to table, counter, cabinet, or window sill.

An Aid to Rapid Lettering

THE lettering guides shown on this page insure rapid and more perfect lettering for the commercial artist or architect. The guide is first placed in the position needed with its upper or lower edge in contact with the edge of a triangle, T-square or other straight edge. Each character is formed by following the edge of the proper opening in the guide with a special pen provided with the outfit. This special pen has a plunger in it and the flow of ink is controlled as needed. No pressure on point of pen is necessary.

A rotary whisk broom



An extension leg for the ladder

A Ladder for Queer Places

AN extension leg for a ladder that will prevent accidents when the ladder is used on a sloping roof or steps or other uneven surface has been recently invented. It is a metal part that is attached to a leg of the ladder; and it may be adjusted in a few minutes. The extension is firmly held at any desired point by strong set-screws and rests on an angular end that does not mar the surface. The extension can be adjusted to any length from one to fifteen inches. Two advantages are that it does not mar the ladder as would a block nailed to it; and it is much safer. When the ladder is placed on steps, the extension part can be lowered to rest on a step or two below the one on which the other leg is placed.

Letting the Vegetables Breathe

THE device shown is a cabinet that permits the entire supply of vegetables and much of the fruit that is brought into the house to be assembled in one convenient place, thus eliminating unsightly boxes, bags and baskets that take up room and create the appearance of disorder and untidiness. The air, which all vegetables must have, is allowed to pass freely around the contents. This keeps them fresh, full-flavored and free from decay. There is no expense of upkeep as there is in providing ice for the refrigerator.

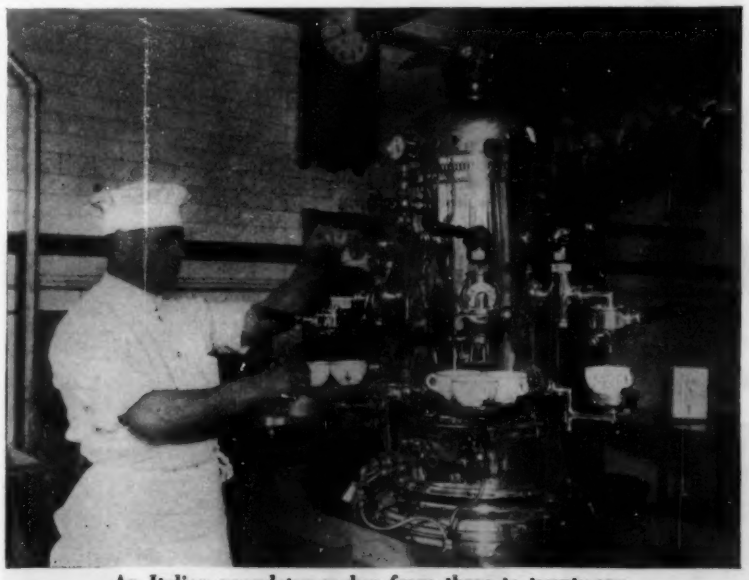
A vegetable safe keeps vegetables and fruits in good condition

Percolated Coffee from the Urn

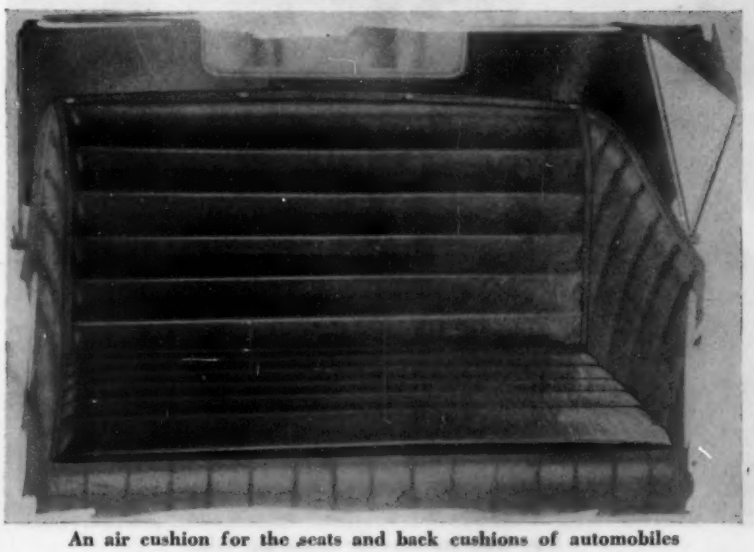
AN Italian concern has developed a multiple percolator for the coffee urn. Three of the percolators are shown in the illustration. Three cups can be filled from each percolator at the same time.

New Comfortable Air Cushion for Motor Cars

THESE two cushions are designed for motor car owners who would avoid fatigue and eliminate shocks, jars, and other vibration. They are made of rubber, and are to be inflated. Like the balloon tire, very low air pressure is used, making a soft flexible seat and back, with a maximum of comfort. They are made to cover front and rear seats and back cushions of automobiles.



An Italian percolator makes from three to twenty-one cups of coffee continuously



An air cushion for the seats and back cushions of automobiles

A holder for the automobile cushion

A Picnic Seat Carried in the Auto

HERE is the picnic seat you have been looking for. A universal support made to fit every cushion in an automobile. It is made of metal, folds flat, and it is carried beneath the seat itself when not wanted. It adds a touch of comfort to your outing.

Doubling the Use of the Kitchen Stool

A HANDY device for the kitchen is a combination stool which when reversed becomes a step ladder to raise the housewife to a moderate elevation. The construction is admirably shown by the photographs. The steps are covered with rubber to prevent slipping.

Ford Plants Immaculately Clean

A RECENT visit was paid to the Ford plants at Detroit; and it was found that, without question, they are among the most remarkable plants in the world. Not only are the power houses up-to-date, but they are places of immaculate cleanliness. The firemen dress in white uniforms; and the shovels, slicers, et cetera, are nickel-plated and are fastened to a frame with the order and precision of an exhibit in a museum. Powdered coal is used throughout the plants.

Combination stool used as step-ladder

The step-ladder becomes a seat

An aid for the study hour

An Adjustable Lap-table

THIS adjustable table is twelve inches wide and eighteen inches long. It folds up to the thickness of an inch. It may be locked in many different positions.

A Novel Bath Tub for Babies

THE combination bath tub and dressing table for the baby illustrated on this page will fit over any ordinary bath tub. When not in use it may be folded up and put out of the way. The tub part is made of rubber with a hole for waste water.

Fingerprinting attachment for check books

Fingerprinting Checks

THE fingerprinting outfit illustrated provides a convenient inking pad and a pad containing a cleansing cream for cleansing the finger after the print has been placed upon the check.

A New Hack-saw Blade Holder

THE accompanying photograph shows a recently invented hack-saw blade holder. It consists of a single piece of steel rod, one end of which is bent into a handle. The rod is provided with a groove which receives the upper, unserrated edge of the blade. Near the handle is a small section

Comparison of the umbrella opened for use and closed

Combined bath tub and dressing table for babies

A new holder for hack-saw blades

A portable machine for measuring light

A comfort to the sick

parallel to the grooved length and having a flattened surface which grips the teeth at the rear end of the blade. To remove or insert a blade, it is necessary to spring the free end of the handle portion slightly outward from engagement with the teeth.

A Stropper for Safety Razor Blades

SIMPLICITY is the most desirable quality of a safety razor stropper. On this page we illustrate one that has simplicity. Roll the roller across your hand; the roller strops the blade. The hand supplies the oil.

A universal stropper for razor blades

A Simple Device for Measuring Light

THE "lightmeter" shown on this page is made up of three principal parts—the telescopic head; a small lamp and battery with their housing; and a rheostat, switch and voltmeter assembly. The operator, in viewing the object, moves the lamp and battery housing in or out until the two ellipses seen through the telescope match in brightness. Graduations on a scale engraved on the tube then give the intensity rating of the light.

A Practical Folding Umbrella

AN umbrella, illustrated on this page, that will fold into a roll ten inches long and two inches in diameter has been invented and perfected by an inventor of Pueblo, Colorado. The handle telescopes and with a few turns of the telescoped handle the top folds. The outer half of the top hinges up and the inner portion of the top folds down. The opening is made automatically by releasing a spring.

Close-up view of collapsible umbrella opened and closed

Stepping off the pneumatic elevator

Stairways are Eliminated

THE accompanying photos show an efficient time-saving system in use in the pressroom of the *San Francisco Chronicle*. As shown in the right-hand picture, a pressman lays his hands on a smooth steel shaft rising perpendicularly from a hole in the floor and disappears from sight. A moment later (as shown in the foreground of left-hand picture), a pressman pops up through an adjoining opening and steps out on the floor. In this speedy way, pressmen pass between the press floor and the paper reels in the basement below. The workman slides down a pole (similar to those used in fire houses); and to return, he steps on a one-man pneumatic elevator which automatically rises to the pressroom level and drops back as he steps off. This equipment saves the pressman a total of about three hundred trips daily up and down stairways.

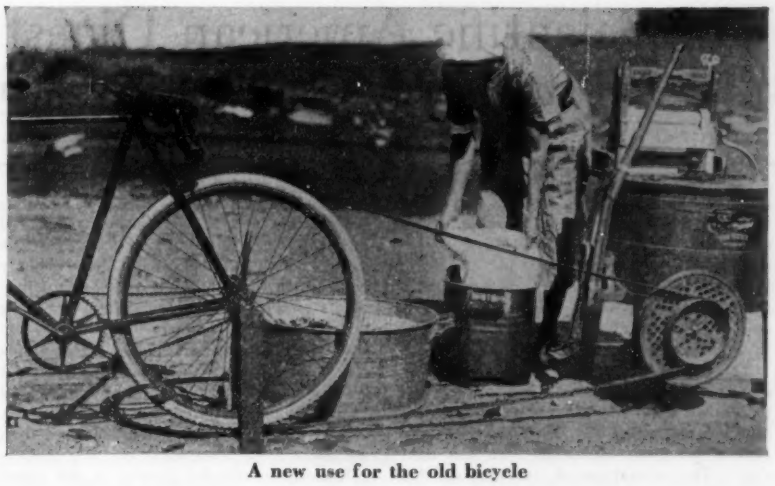
First Aid for the Tennis Player

AT last somebody has invented a carrying case which the tennis player will welcome with pleasure. The case conforms in a general way to the shape of the tennis racket; and there is ample space for sweater, balls and shoes. The racket is tucked out of the way in the cover.

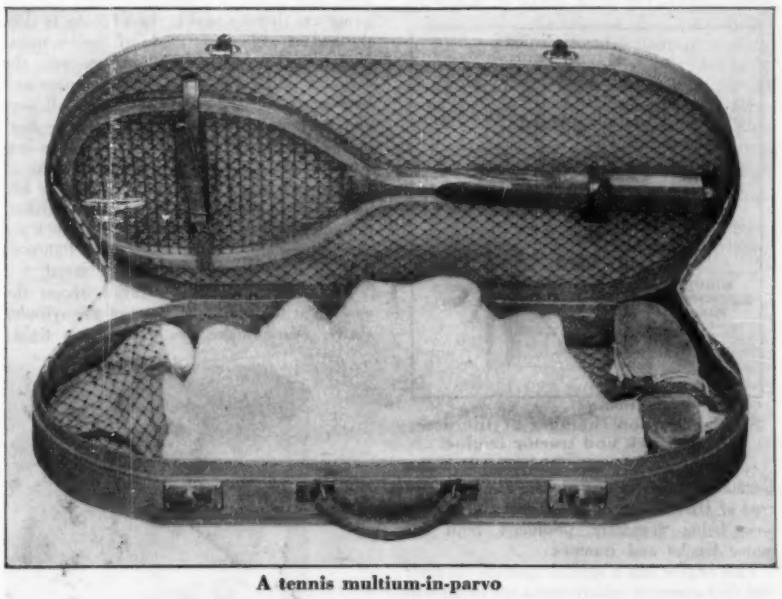
A Safety Automatic Exit Door for Street Cars

TO promote safety, automatic exit doors are being installed on some Chicago street cars. These doors do not open until the car comes to a stop; and they cannot be closed until the passengers are off the steps. An entirely new principle is put into practice in this door in that the weight of the passenger on a steel plate inside the vestibule opens the door, but not until the car is at a standstill. When the passenger steps off the exit step, the removal of his weight causes the door to close again. The doors require no attention of the conductor and are designed to promote safety where conductor and motorman constitute the crew of the car, or for one-man cars, or for cars where two or three are moved together in a train. Already one hundred of these new doors are being used in Chicago. The system is operated by compressed air.

Automatic exit door



A new use for the old bicycle



A tennis multium-in-parvo

Speedy Signature Blotter

A NUMBER of blotters are secured to a desk ruler. This device is not new, yet we thought it worth showing.

A handy signature blotter for the busy man

Sliding down pole to basement

Help for Monday

"BLUE MONDAY" can be made a cheerful day if you have a clever mechanic around the house who still owns a bicycle—or even the remains of one—with the rear wheel working. Of course, it is not quite so simple as it might seem, because you must have a washing machine too.

An Abbreviated Lawn Mower

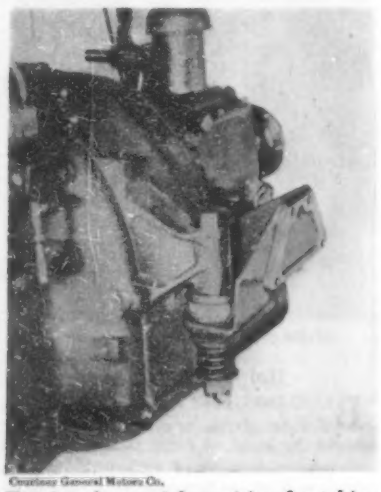
HOW many times have you thought, "If my lawn mower were cut in two in the middle, and the sawed-off ends of the blades run along the house wall or the fence, it would clean the grass right up to the edge, and save that tiresome trimming with sickle and shears?" To meet this condition, a manufacturer has cut a lawn mower in two in the middle, provided a strong plate and outer bearing for the shaft of the cylinder, and suitable bracing. There has also been provided a sharp-edged disk with a little plow-share to throw aside the "edgings." It not only cuts grass, but slices sod, evens up margins, and cleans edges.

A lawn trimmer

The Scientific American Digest

A Review of the Newest Developments in Science, Industry and Engineering

Conducted by Albert G. Ingalls



Courtesy General Motors Co.

Showing the special provision for taking up the side thrust

Some Features of 1926 Motor Trucks

In our January issue, Mr. W. H. Slauson outlined some of the features of the 1926 automobile, and it will be of interest, therefore, to call attention to some of the developments which will be noticeable in automobile trucks.

Perhaps the most radical line of advance of all is the adaptation of the Diesel engine to commercial operation. Shall we drive our trucks, and possibly our motorcars, with Diesel, heavy-oil engines? It begins to look as if this advance were due to arrive within a few years.

The Diesel engine has always been considered hopelessly heavy for such service. Owing to the high compression involved in this type of motive unit, and to other reasons, it has been necessary to provide great strength and rigidity in the structure of the engine itself; and this, in turn, has involved great weight. Ways have now been found to make the Diesel engine available for truck service, while experiments are being made at Langley Field with ordinary Liberty airplane engines altered into Diesel engines. The results however in the latter instance have so far been unsatisfactory.

What are the characteristics of the Diesel engine that make it more desirable, for certain work, than the gasoline engine? For one thing it burns low-grade oil, although this is not its distinguishing feature. Its unique feature is the fact that the fuel is ignited by heat generated when air is compressed in the return, or compression, stroke; therefore no spark plugs or other similar ignition apparatus is required.

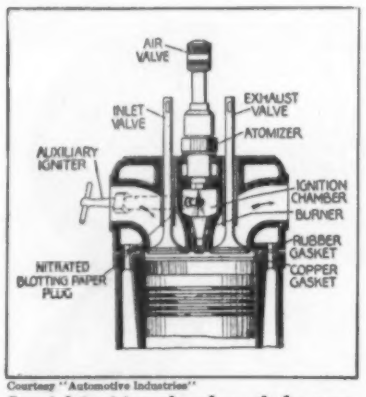
Have you ever noted how hot a tire pump becomes? This is not due alone to friction, but largely to the heat engendered when the air is compressed. If you take a cubic foot of air and compress it into one-half cubic foot space, you have given one-half cubic foot of air the quantity of heat that formerly existed in one cubic foot.

Now this is what happens in the Diesel engine. The air that is forced into the cylinder during the cleaning or scavenging stroke is compressed, on the return or upward stroke, to about one-thirteenth of its original volume, or to about 450 pounds per square inch. This automatically raises its temperature to 800-1,000 degrees, Fahrenheit. At the moment of highest compression, a spray of fuel oil, under still higher outside pressure, is injected into the combustion chamber and small clearance space between the piston and the cylinder head. Combustion now takes place at once.

The high pressure is not, however, rapidly reduced as the piston travels down, as is the case with the ordinary gas engine, but since the fuel does not explode but continues to burn through a part of the stroke, the pressure is in a comparative sense maintained. This is why a Diesel engine is called a "constant-pressure" engine. It is in a measure like a steam engine.

The ordinary gasoline engine consumes about one pint of fuel per hour per horsepower, while the Diesel engine delivers one horsepower during one hour on one-half a pint of low-grade oil, or on even less than this. The advantage of introducing this type of engine into regular motorcar and even airplane service is obvious, provided the necessary adaptations can be made successfully. This problem now greatly interests automotive engineers.

Two years ago, says *Automotive Industries* (New York), the Benz works of Manheim,



Courtesy "Automotive Industries"

Special ignition chamber of the new Diesel truck and tractor engine

Germany, first exhibited their automotive type of Diesel engine, and Diesel engines are now being regularly produced both for motor trucks and tractors.

This engine has a special ignition chamber and fuel atomizer which works under an outside pressure of 1,000 pounds per square inch. The illustration above shows the various parts. Gas oil, yellow and brown paraffin oil, tar oil and crude oil, including Texas oil, can be used providing the viscosity is not too high.

The truck type of Diesel engine has four cylinders instead of the two used for tractors; also an electric self-starter. The bore is 4.93 inches; the stroke, 7.09 inches. The consumption of fuel is stated to be .53 pound of fuel per horsepower hour.

The Langley Field experiments with a Diesel engine for airplane purposes are being reported in two articles in *Power* (New York) and are too long to summarize here. Editorially, *Power* says that although a Diesel aviation engine can not be made of a converted gasoline engine (the experiments apparently tore a Liberty engine to pieces pretty quickly, the brasses, journals and so on "going out" under the greatly enhanced stresses) the work that is now being done points the way to ultimate success.

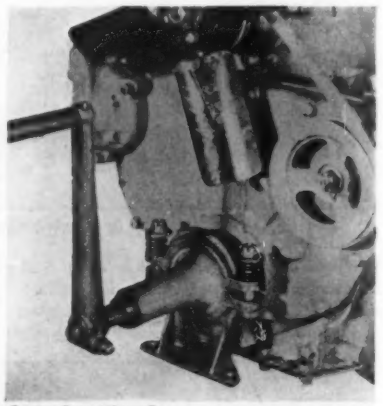
It is a long way from the extremely heavy Diesel engine used for stationary and marine purposes to a Diesel engine light enough for aviation, but this is a development which may be expected in the near future.

Another feature which materially affects the life of the truck motor is the elimination of vibration by means of three-point suspension, where the center point is the forward end. An extension of the timing gear cover, through which the hand starting crankshaft extends, is carried in a bracket mounted on a cross member of the frame. This bracket is bored out to a larger diameter than the starting crank housing; a rubber ring fits the housing and is contained in the bored recess of the supporting bracket. This acts as an insulator at this point. The assembly is shown in the accompanying illustration.

The two rear supporting points are arms or lugs extended from the fly-wheel housing. Interposed between the bracket on the frame and these arms is a rubber insulator biscuit inclosed between two stampings, which have extensions turned up on them which register both in the bolt hole in the bracket and in the motor arm. This takes the side thrust.

Removable cylinder sleeves in the motor itself permit the replacement of scored cylinders within an hour's time without demounting the cylinder block. Thus, standard dimensions are maintained for piston and ring and the laborious and costly grinding of cylinders to oversize, installing oversize pistons, and so on, is eliminated; time and expense are thereby saved. In addition to this, the separate sleeve is made of harder metal having a better wearing surface, and the cylinder walls are of uniform thickness and homogeneity, for they are machined all over and show uniform expansion under the heat of the explosive gases. This uniform expansion permits closer limits in the fit of the pistons, which in turn means longer life and a more efficient work cycle. Further, the crankcase and cylinder-carrying block are cast in one piece, thus making for lightness and for the better distribution of metal.

The accompanying illustration shows the gaskets at the top and bottom of the cylinder sleeve, which make the water-jacket tight;



Courtesy General Motors Co.

Three-point suspension (note bearing under the front of the engine) eliminates much of the vibration

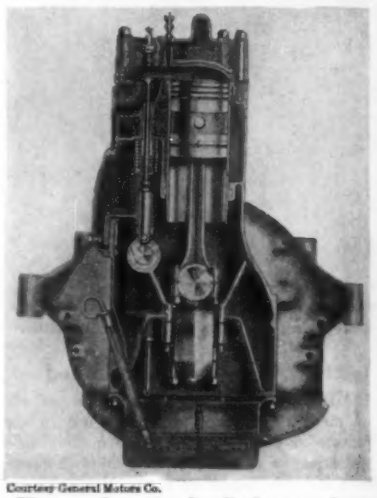
also the one-piece casting feature of the entire engine, and the rear suspension lugs on the side of the motor.

* * *

Power from the Wind

In sections of the country where there are fairly steady though not necessarily high winds, with few calm spells, a windmill driving an electric generator, with a storage battery floated on the line, has made good. Several of our readers have inquired why such equipments have not driven gasoline-electric power units entirely off the market. The gasoline costs money, they argue, while the wind is free.

If this were the whole of the matter there is little doubt that the wind equipment would be the survivor. But there are several considerations not immediately apparent, which offset the superficial factors. Undoubtedly, however, the natural inertia of human beings has helped to some extent to prevent the development of the windmill-electric equipment, for the gasoline equipment is well established. It has proved satisfactory and its over-all cost is very



Courtesy General Motors Co.

The crankcase and cylinder-carrying block are cast in one piece

little more than that of the wind equipment.

In one of the Annual Reports of the Smithsonian Institution there is a paper on wind power, in which several fundamental windmill considerations are taken up, the more pertinent of which interest us here. The common American type of windmill develops about twelve percent of the available energy of the wind. Taking the average of seven weather observatories near the western and southern coasts of the United States, a wind velocity of four miles an hour and upward is experienced during about 7,500 out of the 8,760 hours of the year; while the velocity most frequently noted is fifteen to seventeen miles an hour. In the East, and inland, there is just a little less duration than that just given, but the prevalent velocity is lower, being between eleven and thirteen miles an hour.

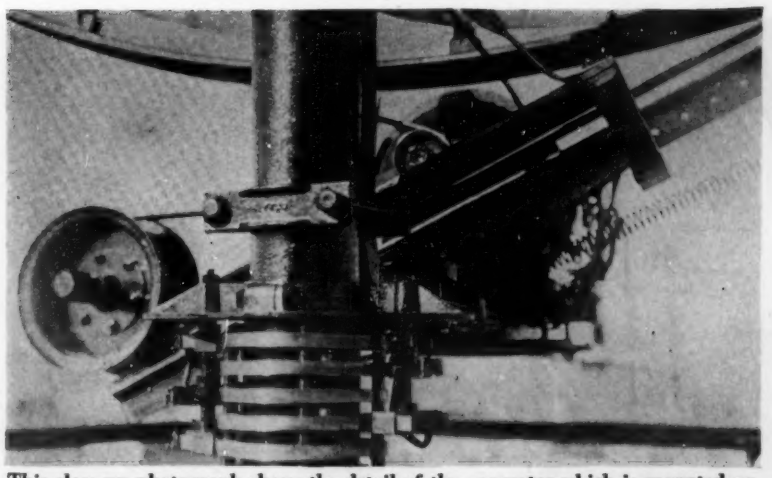
In the November, 1924, issue of *Mechanical Engineering* (New York), the official organ of the American Society of Mechanical Engineers appeared an article, "Wind Power for Farm Electric Plants," in which the statement is made that, according to the United States Weather Bureau, the longest calm or period of continuous low wind velocity below five miles per hour, is thirty-

Courtesy "The Engineer"

The aerodynamo, a new type of windmill with blades designed on the airplane principle. The wind is blowing away from the reader

Kadel & Herbert

This is the Savonius wind-motor, invented by a Finn. A plan of the same rotor is shown below, right half



This close-up photograph shows the detail of the generator which is mounted on the Montana windmill shown at right. Note the collector rings, which permit electrical contact in all positions of the windmill; also the motor and pulley

A windmill at Culbertson, Montana, generates electricity for operating signals on the Great Northern Railway

four hours for the Middle West, varying with the locality. Power can be generated in all winds above five miles per hour, but the ordinary type of wind wheel is not efficient for such operation.

A wheel thirteen feet in outside diameter with blades three feet long, it is stated, will give ample power for an electric plant suitable for a modern farm in the middle west, but the characteristics of a windmill are not favorable for large units, a twenty-foot wheel being about the largest size that can be used and give satisfactory result. The first cost, cost of operating, and depreciation compare very favorably with those of gasoline lighting plants.

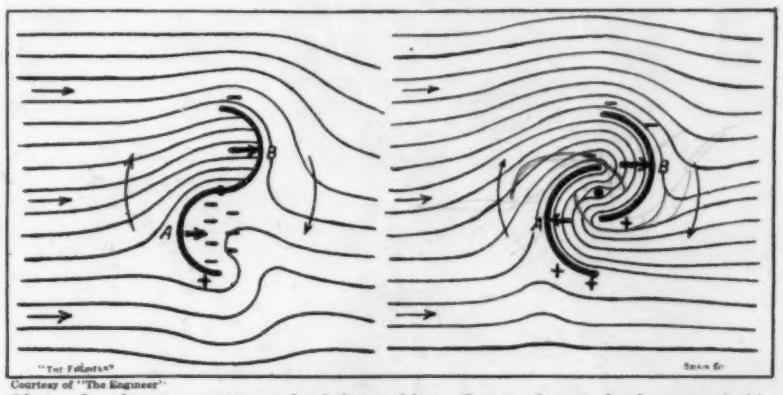
The last sentence quoted is significant; although gasoline costs money, while wind is free, there is not the difference in ultimate or last cost that one would be led to expect.

The old Dutch-type windmill was extremely inefficient, making use of only three to five percent of the available energy of wind. The ordinary American type having sheet metal blades is better, but it will be evident that considerable improvement should be attained in the new development of adapting the thicker airplane blade to the windmill. Such a windmill, having aerofoil arms, has been built in Germany, and is now on trial by the Institute of Agricultural Engineering of Oxford University at Harpenden, England.

As a result of researches made and practical experience obtained during and since the war, we now know that it is not entirely the up-thrust of the air on the wings of an airplane that keeps it from falling, but rather a combination of the vacuum above the wings and the pressure of the air underneath, that holds the machine in the air. It is not wholly the air pressure on the front of a racing automobile that retards it, but a resultant of the suction of the vacuum behind, and the front pressure. It is, again, not the pushing effect of the wind on the sails of a ship that propels it, as has always been supposed, but again a combination of suction and pressure. And it is not, as we have assumed for 5,000 years past, the wind that hits the face of a windwheel alone that turns the wheel and performs useful work, but the pull of the moving air stream on the back of the wheel and the pressure on the blades. That was the prime discovery of Major Bilau, a German investigator who has made a new windmill blade that utilizes a maximum of the available wind power.

The problem was to develop the incident force on the *back* of the blades, where it could exert the maximum pull. This means, first of all, that instead of making the wheel face the wind, it has to be turned away so that all the other attachments including the vane shall be in front. The wind *leaving* the wheel would, therefore, be free from all disturbance; the stream line of the air current would not be broken up; and the shape of the blades of which there are only four on the aerodynamo—as it is called—is shell-like, the hollow being turned to the wind. The wind striking this hollow is guided by its peculiar shape, over the cutting edge of the blade, which, it will be noticed, is not thin as one would expect, but very thick.

A thin edge favors the formation of vortices in the air at the rear edge of the blades. These vortices are a retardant; but the thick, curved edge does not permit the formation of such vortices.



Courtesy of "The Engineer"

Obviously, the air-scoops on the left would revolve in the wind; the remarkably increased efficiency, due to placing them as shown at right, was striking. The turning moment was multiplied three times

In all windmill construction, one of the difficulties has always been the finding of some means of utilizing all ordinary wind speeds from the gentlest to the heavier without risking injury to the machine. This is achieved in the aerodynamo blade by a special aerodynamical principle. Near the end of each blade will be seen a small projecting "fin."

The fin is situated at a very critical aerodynamical point. If there were no fin, at moderate speeds all the wind streaming *along* the surface of the tip of the blade would pass off at the sharper edge where it would set up "goat's horn" vortices and thus retard the motion of the wheel. When this portion of the air stream hits the fin, however, it is deflected right over the tip of the wheel and does not stream off at all. When, however, the wheel is revolving *too* fast, the fins automatically turn parallel with the blade. Vortices are then formed at the sharp edges of the blades and these act as a brake.

The electrical part of the aerodynamo is all contained in the egg-shaped body placed on the windward side of the mill. The voltage of the current generated by the aerodynamo remains constant, independent of the speed at which the wheel revolves, while the amperage varies with the speed.

The wheel begins to turn with a wind speed of about six and one-half miles per hour, and can, it is claimed, safely utilize all wind speeds up to forty miles per hour without injury. The size of the storage battery chosen will depend on the winds prevailing at the spot where the aerodynamo is put up, and the amount of current wanted at the farm in question for lighting, cooking, laundering, and driving various forms of machinery. The first aerodynamo put up near Berlin is fixed at the end of a ferro-concrete mast, about fifty-three feet high. It has a span from tip to tip of the wings of twenty-nine and one half feet, weighs eight tons when packed for transport and works regularly in average winds, producing ten kilowatts or about fourteen horsepower.

An American development of the aeromotor will be evident to passengers speeding to the Northwest, who may be a little surprised after entering the state of Montana to see, not far from the tracks, a trimly built windmill and to learn that it generates electricity to operate the block signals for a distance of twenty-six miles. The fourteen and one-half foot wheel that is mounted on this sixty-two foot tower would not be of much service for furnishing electricity if it were not carefully designed. The blizzards that sweep across Montana and the Dakotas are enough to wreck most windmills. This wheel is so designed that when the wind pressure gets too strong, the blades turn and allow the wind to sweep on through without damaging the wheel.

The power outfit has a unique drive that connects the generator to the wind turbine. Over the periphery of the wheel is mounted a belt sheave that takes a special weather-proof belt. The electric generator is located directly below the wind wheel, easily accessible. The whole installation has maintained steady, dependable power and foreshadows a broad field of utility.

Windmills of the more modern type have had considerable post-war development in Denmark, where large wheels are in use. These are not simply the old-style "Dutch" windmills, but are far more efficient machines. Their sails are metal instead of canvas, and they have an automatic self-reefing device to allow for heavy puffs of wind. They are made in sizes up to about fifty feet in diameter.

The August 21, 1925, issue of *The Engineer* (London) contains an account of a device called the wing rotor. This is a device which revolves in the wind on a vertical axis, the metal vanes being curved in the position shown on the right side of the accompanying diagram. This wing rotor was developed by Captain Sigurd J. Savonius of Helsingfors, Finland.

Starting with the design shown on the left, it is self-evident that this would turn in the wind and would develop some power. Now if we overlap these sections a surprising thing happens: the peripheral speed of the rotor, which in the first type was just equal to the velocity of the wind, goes up to 1.7 times that of the wind; while the turning moment increases to three times the former case!

* * *

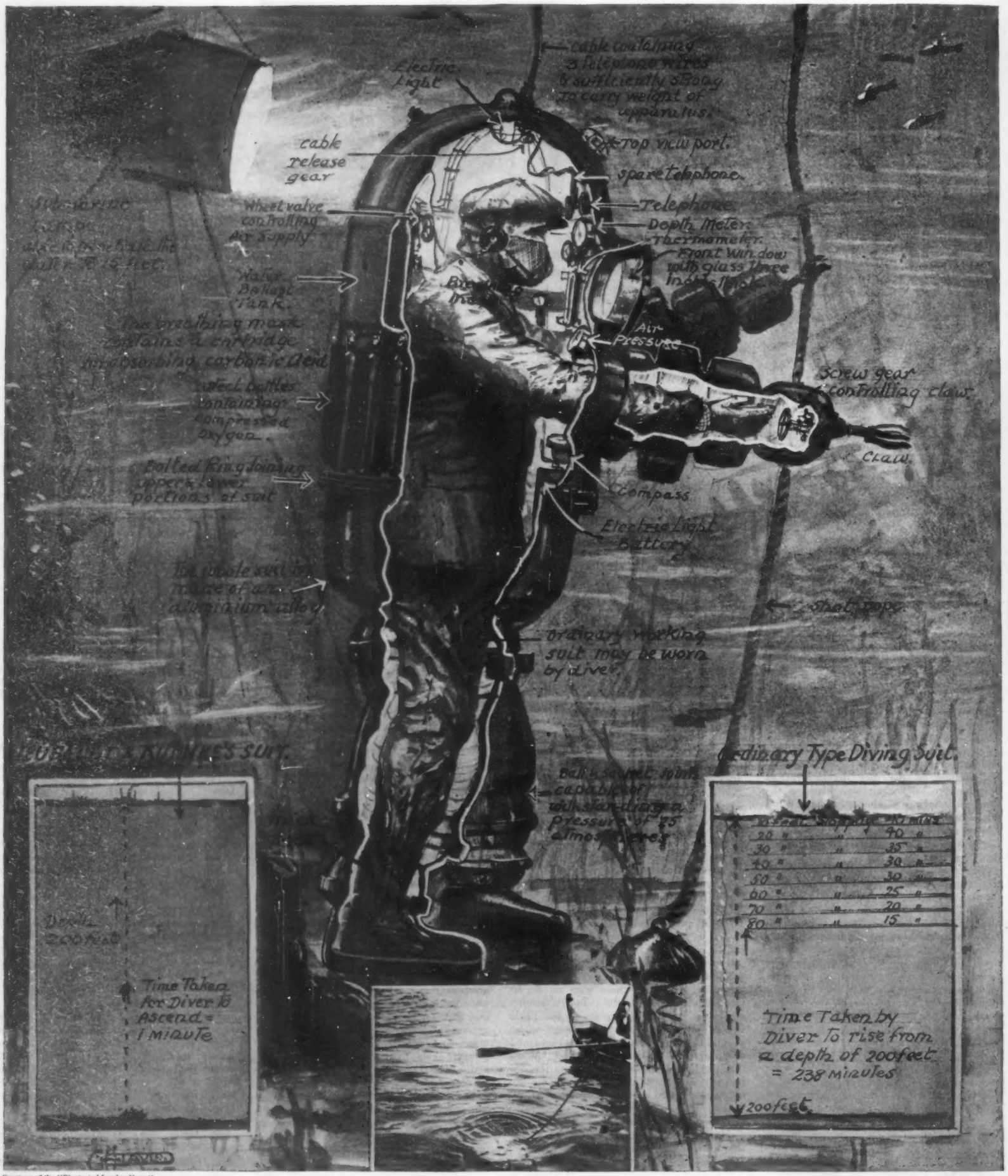
How Did Man Make His Weapons Before the Old Stone Age?

THE January issue of the Scientific American contained, on page 20, an interesting article entitled "Men of the Early Glacial Epoch," from the facile pen of the noted British anthropologist, J. Reid Moir. In it, the author depicted the primitive setting in which man of 500,000 to 1,000,000 years ago dwelt, hunted and fought in a land that now is England.

What we know today of these earliest known human cultures—the Foxhallian and Cromerian—is chiefly owing to the indefatigable efforts of this writer, Mr. Moir. Two excellent books written by the same author are: "Pre-paleolithic Man," and "The Great Flint Implements of Cromer, Norfolk" (both published by W. E. Harrison, Ipswich, England).

Those who enjoyed Mr. Moir's article in the January issue and became interested in his depiction of the savage human who inhabited northwestern Europe when it was a sub-tropical country before the Great Ice invasion will discover in these works a mine of information. "Pre-paleolithic Man" is chiefly devoted to a painstaking consideration of the art of flint-knapping, and the reader who cares to imitate the stone weapons of primitive man or of the American Indian will find it invaluable as an instruction book.

The other book mentioned is an exposition of the Cromer flints, made by a race of men whose hands were obviously greater and stronger by far than those of any living race. Some years ago, scientists denied their human origin—said they were accidental products of nature. To prove his case, Mr. Moir wrote this book. Science has now accepted the Cromer flints.



Courtesy of the "Illustrated London News"

A Deep Sea Diving Suit to Reach Sunken Submarines

EVERY now and again the world is appalled by the loss of a submarine. Hitherto, the sinking of an underwater craft has meant almost certain death for the entire crew, even if the position of the wreck is immediately located in shallow water. Where the sea bottom has been more than 150 feet down, however, it has been impossible to reach wrecks, owing to the limitations of diving equipment and of human endurance. It is interesting to learn, therefore, that for more than a year a firm of German engineers, Neufeldt & Kuhnke, of Kiel, has been experimenting with a deep sea diving suit; and that when, last November, the British submarine *M1*, was sunk with a loss of the entire crew of sixty-eight men, the British Admiralty cabled to Germany and two of these diving equipments were rushed with the greatest possible speed to the scene of the disaster on the British destroyer, *Wolfhound*.

Comprehensive tests in a mountain lake in Upper Bavaria have shown that divers can go down in these suits to a depth of 500 feet, without danger to health or body and without feeling the enormous pressure that prevails at such depths.

From its outward appearance the apparatus

resembles the armor of a knight of the Middle Ages, and is made mainly of Siemens-Martin steel. Sufficient room is allowed in the trunk portion for the diver to withdraw his arms from the sleeves which encase them, to perform any particular operation. At the belt level it is sub-divided into two sections joined by a flange. In front, each side, and on top of the upper section, substantial; closed windows are placed. Provision is made for a signaling apparatus, controlling devices, measuring instruments and breathing outfit. (See opposite page.)

In the lower sections sufficient space is afforded for the balancing and descending weights, together with seating accommodation for the diver. The covering for the arm and legs is made of a tough aluminum alloy, allowing the diver complete freedom of motion. The limbs of the suit are fixed to the trunk by specially designed, hermetically sealed joints.

Universal Trade Press Syndicate

The diver, encased in his pressure-resisting, jointed armor, is being lowered into the water

To insure the greatest possible ease of diving and rising an annular diving tank and two lateral tanks are provided. Descents are made by simply opening valves, so that the tanks fill with water. When it is desired to get back to the surface, the water is forced out of the tanks by means of compressed air or oxygen.

A return descent to 500 feet can be accomplished in four minutes. With the ordinary type of suit, operations between the surface and 100 feet occupy an hour. Only at that slow rate can a trained diver adjust himself to different pressures at varying depths. A battery and six compressed air cylinders at the rear wall of the trunk provide the means of emptying the tanks.

A special oxygen bottle and two to four regenerating cartridges, each with a life of two hours, serve to supply the diver with plenty of fresh air. Diving with these suits is much safer than with suits of ordinary design.

By the new method the diver has a treble connection with the surface—by a line, which in case of necessity is pulled by the diver; by an arrangement for sending out Morse telegraph signals; and by direct telephonic communication with the tender. Experiments have proved that a diver can see to a distance of four feet when at a depth of 350 feet; but total darkness prevails at a depth of 500 feet.

The new diving suit opens up a wide field for submarine research, for apart from the reclamation feature, from a purely economic standpoint, the deep sea diving suit will provide greater opportunity for the collection of such commodities as sponges and pearls. It is well known that much larger sponges and pearls exist beyond the present range of fishing activity, than those now obtainable.

Perhaps the greatest advantage of all is that no special training, either technical or physical, is necessary for a man to go down as deep as 750 feet in one of these suits. They can thus be utilized at any time and by anybody.

* * *

Literature and Materials for Telescope Mirror Making

OWING to limitations of space imposed by the length of the article beginning on page 86 of the present issue, the following list of literature on telescope making and sources from which materials may be had have been moved over into these pages.

Mr. R. W. Porter, the author of the article on page 86, continues as follows:

A full account of making telescope mirrors could not possibly be brought within the bounds of these articles. Fortunately, this is not necessary, for a most excellent book, "The Amateur's Telescope," by the Reverend William F. A. Ellison, Director of Armagh Observatory, Ireland, has recently appeared, and since the Scientific American has just obtained the right to republish this book in the United States, expressly for this occasion when a large number of American amateurs will need it, it may now be obtained by anyone desirous of making his own instrument.

Ellison goes to great pains to explain every step of grinding, polishing and testing, and in describing home-made tools that are inexpensive. He is clear and concise in his statements. I regret that the book is not more fully illustrated by photographs, but those accompanying the present article will help, and some assistance may be found in my article in *Popular Astronomy*, listed below.

Until the appearance of Ellison's book there was very little available literature on mirror making, and much that was available was fragmentary and scattered. The works by Draper, on the construction of a sixteen-inch mirror, and by Ritchey, "The Modern Reflecting Telescope," both of which are classics, are now out of print. They appeared in the *Smithsonian Institution Contributions to Knowledge* (Volume 34; 1904), and were reprinted in the Scientific American Supplement for December, 1904, and January, 1905 (Ritchey); also July-August, 1905 (Draper). These may be found in some libraries, but I am advised that the supply in the hands of the Scientific American was long ago exhausted. These articles are not very useful to the tyro. An excellent article by the Rev. C. P. Davies may be found in the *Monthly Notices* of the Royal Astronomical Society (listed below). Also, see back files of the magazine, *English Mechanics*, which are full of articles and correspondence by English amateurs, of which there appear at present to be many more in Great Britain, especially among the clergy, than in the United States. This comparative scarcity of amateur astronomers in America may, it is hoped, be largely remedied through the renewed interest in telescope making which the Scientific American is attempting to arouse.

The available literature on mirror making thus consists of the following:

Ellison, *The Amateur's Telescope*, reprinted 1926, by the Scientific American Publishing Co., 233 Broadway, New York, price, postpaid, $2.00.

Monthly Notices, March, 1909, Royal Astronomical Society, Burlington House, London, W. 1, England, price, postpaid, two shillings, six-pence.

The Poor Man's Telescope, by R. W. Porter, in *Popular Astronomy*, November, 1921. Out of print. In some public libraries.

Knife-edge Shadows, by R. W. Porter, in *Astrophysical Journal*, June, 1918. Out of print. Consult in libraries.

Methods of Silvering Glass, Letter Circular LC 32, Bureau of Standards, Department of Commerce, Washington, D. C., gratis.

The following list of sources from which the amateur may obtain materials is not exhaustive and includes merely those firms with whom I have had satisfactory dealings while making hundreds of optical surfaces:

Pittsburgh Plate Glass Co., Pittsburgh, Pa., two commercial, polished, plate glass discs, diameter six inches, thickness one inch, ground edges, slightly chamfered, price, about seven dollars.

The Carborundum Co., Niagara Falls, N. Y. (branch offices in large cities), carborundum grains, one pound can of each, Nos. 80, 120, 280 ("1 minute"), 400 ("15 minute"), 600 ("60 minute"). Prices range from 40 cents to 80 cents per can; obtain price list. Much care should be taken not to contaminate smaller sized grains with grains of larger size.

Emery: The Hamilton Emery and Corundum Co., 30 Church Street, New York, N. Y. One pound can of number 6F turkish emery, at fifty cents, post paid.

Wilmington pitch may be obtained from some hardware and ship chandler's stores at about 10 cents a pound. Any grit contained may be removed from it by straining through cheesecloth while hot. An alternative to pitch is rosin (easily secured), tempered to proper degree of hardness by the addition of turpentine.

A. P. Munning & Co., Matawan, N. J. One-half pound of best grade optician's rouge at $1.06 per pound, plus postage.

Chemicals for silvering may be obtained from the drug store. They must be chemically pure.

Courtesy Fresno County Commission of Horticulture

Barefoot boy on a puncture vine. "You people may think this is funny, but I can't see much humor in it"

Lamp: Any kerosene lamp can be used, but a small one is preferable, since the knife-edge and eye may thus be brought close together. I have found it possible to bring the knife-edge within less than an inch of the pinhole when using a little kerosene lamp supplied by The Vapo-Cresolene Co., 62 Cortlandt St., New York, for 40 cents, postpaid (postage stamps are accepted).

Lastina lacquer 15M, for protecting silvered mirror surface, may be obtained already diluted six to one with amyl acetate, from The Egyptian Lacquer Mfg. Co., 90 West Street, New York, N. Y. One-half pint $1.00, postpaid. Request 6 to 1 dilution.

[EDITOR'S NOTE: In considering the important question of how the amateur might obtain all the various materials necessary for making his mirrors and mountings, with the assurance that the proper kind will reach him, the Scientific American cast about for someone having an intimate understanding of the beginner's needs, who would assume the responsibility of handling them. Mr. John Pierce, of 11 Harvard Street, Springfield, Vermont, a member of the group of amateur telescope makers and astronomers described in the November Scientific American, was finally prevailed upon to do this work for those of the amateurs who do not make their purchases separately from the several sources named above. Mr. Pierce is not, however, a regular dealer, but is a teacher of vocational training in the high-school at Springfield (Vermont) and he was chosen because he has already made several telescopes and therefore has an exact insight into and a sympathy with the peculiar requirements of the beginner; also because he is in daily touch with the author of the article on mirror making, published in the present issue.]

There is a quite prevalent impression that the production of lenses and mirrors and optical surfaces in general is shrouded in mystery, and that the professional producers jealously guard their secrets of manipulating glass. While I have found the latter to be, unfortunately, true, there certainly is no mystery about glass working. The sole reason that those capable of producing large optical surfaces in this country is confined to a mere few, is the infinite capacity for taking pains which is required. If, however, the amateur could see the workrooms where Petididier, McDowell and the Clarks created their masterpieces, he would find no elaborate machinery and equipment. But these masters are gone, and those who remain may be counted on the fingers of one hand.

R. W. Porter.

* * *

What Is the Puncture Vine?

A ROADSIDE weed known as the puncture vine, which penetrates the outside of automobile tires is one of the pests with which the California motorist has to contend, according to *California Highways*, a bulletin issued by the California Highway Commission largely in the interest of good roads.

With curious intermingling of science and humor, the true scientific name given to the puncture vine is *tribulus terrestris;* it has indeed forced its tribulations upon those who try to cross its foliage, either with motorcar or bare feet. Each bur of this peculiar weed bears two sharp, pointed spines, and the bur is so balanced that one of the two spines always points upward when the bur is lying on the ground.

These burs are about as long, and nearly as stout, as an average carpet tack, and since five burs make up one cluster, there are on each cluster ten points, several of which are always business end up. To complicate the matter still more, one plant may bear 10,000 burs, not only to puncture the tire of the car which passes over them, but the skin of him who sits on them.

The puncture vine, it appears, is not a native American, but came over from somewhere in the region of the Mediterranean, as a stowaway, along with ballast in a ship that docked in Texas. Since Nature's purpose in providing this vine with seeds in the form of burs was to permit them to attach themselves to moving objects for a free ride to a new country, it rapidly traversed the southwest, and seems now to have made its main home in sunny California.

Along the highways the puncture vine quickly spread, for the heavy burs picked up by passing motor vehicles were distrib-

Courtesy Fresno County Commission of Horticulture

Automobile tires carry the burs of the puncture vine long distances

uted by the same medium. The vine is still spreading. Fortunately, however, the present-day tire, with many plies of rubber and fabric or cords, is almost immune from actual puncture, but the spines, nevertheless, break off in the tread of the tires and work through the fabric when the tire is well worn. This shortens the life of the tires.

Livestock pick up the burs between their toes, and this often causes them serious infections. They even get the burs under their tongues, causing ulcers. Grape pickers know better than to kneel in infested vineyards—at least, those who have tried it once know better.

Can the puncture vine be controlled? Not entirely. Hoeing would be necessary once a week, for the seeds, maturing quickly on the vines, sprout at different parts of the season. The road grader simply spreads the seeds, planting them nicely under a thin mulch of soil. It has been found, however, that various petroleum oils saturate the burs and kill them, and these methods are now being employed in an effort to drive the pestiferous puncture vine off the highways, at least of California.

* * *

Our Telescope Makers

EVIDENTLY there is a strong latent interest in telescopes and amateur astronomy throughout this country. Everybody, seemingly, wants to make a telescope. Everybody, at some time during his life, has had the desire to own, not a small spyglass, useful as this type is for learning astronomy, but a telescope capable of doing real, satisfying astronomical work of possible value, in some cases, to science. Most of us, however, have had to suppress this desire; we could find other and more pressing ways to spend the several hundred dollars which such a telescope would cost.

With these facts in view, it seemed advisable, last summer, for the Scientific American to attempt to stir up interest in the home-making of reflecting telescopes, a type of instrument which, unlike the refracting telescope, can be made by the amateur himself, and which costs comparatively little. In order to arouse the interest, not merely of the few who already know more or less about the mirror-making art, but of the many more who may have been misled by the persistent fiction that, since the perfecting of large mirrors requires the work of a born mechanical wizard, the smaller sizes do also, the article, "The Heavens Declare the Glory of God," was published in the November Scientific American, and was purposely kept non-technical.

Gratifying, indeed has been the response to it. Direct requests for instructions on telescope making were subsequently received from the 314 readers represented by the dots on the map shown in this department of the magazine. We may also assume that several times as many more readers will become interested through reading Mr. Porter's article in the present issue; while nearly all of both groups of beginners may be counted on more or less to arouse the interest of groups of local friends in mirror making, thus incidentally making themselves the nuclei of these groups, and possibly of local clubs. It is hoped that all who are making telescopes and who have not written to us will do so. We are interested.

Thus the prospects are bright for a renewed interest in amateur astronomy in America, just as in Great Britain, where there are—and long have been—hundreds of amateur telescope makers who have learned the art of parabolizing mirrors with fair accuracy and who keep more or less in touch with one another in their work. Why should we in America go on permitting them to excel us in this interesting line of scientific endeavor?

Daily for several weeks, a batch of enthusiastic requests for instructions for mirror making have reached our desk, and the reading of these letters has shown us who the people are that want to make telescopes, also that most of them are keenly interested. They include people in all sorts of occupations: young people, old people, professional men and business men, a few women, many physicians (whose future patients, calling them suddenly away from their mirror polishing, will wonder why their hands are red with rouge!), a college president, several dentists, a number of youths eager to begin, quite a number of teachers of science with classes which they wish to interest, several lawyers—these are the kind of people, judging by their letters, who want to make telescopes.

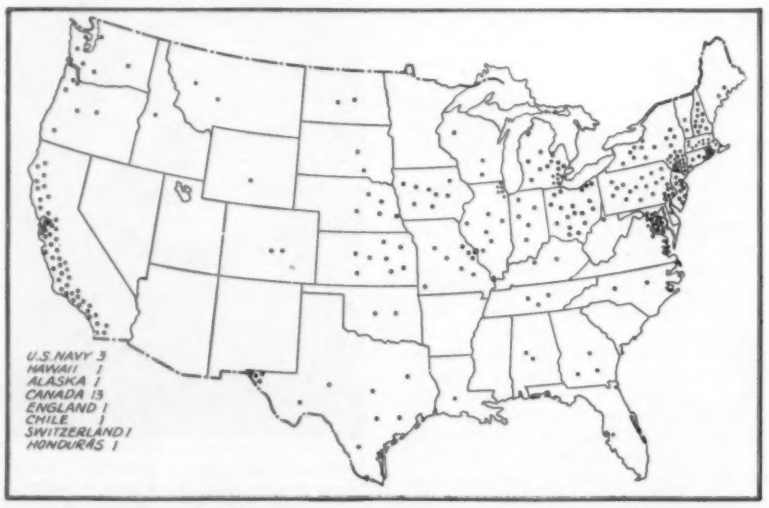
Here are some more, chosen at random: a jeweler; a letter signed by four who will probably work together (four heads are better than one); a dealer in granite; a letter under date line, "U. S. Air Mail Service" (an aviator?); a Jesuit priest; a schoolboy; a plumber; a Lutheran pastor; the manager of a famous electric lamp manufactory; a man who "has ransacked large libraries, in vain," looking for instructions on telescope making (there never have been many, for the literature on telescope making is extremely scanty and has been comparatively unavailable).

Other would-be telescope makers are: an electrical engineer; a seaman on the airplane carrier, *Patoka;* a farmer; a civil engineer; the principal of a high-school in Chicago; the president of a missionary movement; a student of medicine; a fruit farmer; a man who has already gone ahead and bought a glass disc (he must have *two*, however); another man who strongly doubts whether the real, inside secrets will be revealed! (the secret is patience); a man who writes that our article in the November issue was "about the fifth he has read, all of them telling it was easy, but none how!" (it is not "easy").

Thus we present a small, random cross-section of the group that wishes to make telescopes. Out of all these beginners it may be confidently anticipated that a number of experts will gradually develop, and that, perhaps, a few positive geniuses at glass working may be discovered—men who do not even know at present that they are potential geniuses in this careful work. In this connection, Ellison explains in his book, "The Amateur's Telescope," that most of the really great makers of the *large* mirrors began as rank amateurs and, almost self-schooled, beat the existing professionals at their own work.

Courtesy of the Baltimore & Ohio Railroad Co.

The largest passenger locomotive in the world, built last June by the Baltimore & Ohio Railroad Company, shown in comparison with a passenger locomotive which is a fairly large type itself



Each dot is a potential amateur's telescope, representing a reader who has written the Scientific American, requesting the publication of instructions for making reflecting telescopes. Up to December 10, there have been more than 300 such requests—count the dots—and more were still arriving. No effort was made to locate the dots more accurately than within the proper states

Late in November, 1925, the writer had occasion to spend a week-end with Mr. Russell W. Porter in his Vermont home, and on that occasion the letters from our enthusiastic would-be telescope makers were taken along. On one day we met with *The Telescope Makers of Springfield, Vermont,* at Stellar Fane, described in the November Scientific American.

Arriving on the mountain-top in the afternoon, we found a dozen of the members already there, having a wood-cutting "bee" which resulted in the reduction of several logs to fireplace fuel for the astronomers' winter comfort. Next came another kind of "bee," when fourteen men sat down to the laureate-cook's steaming repast. Finally, when the table was cleared, the members of the group sat in a big ring around the fireplace, busily engaged for an hour in reading the interesting letters received by the Scientific American from people who want to become amateur astronomers, like themselves. These men of Vermont were literally delighted over the widespread and enthusiastic interest in telescope making which was proclaimed by the letters from our readers.

Later, a day was spent with Mr. Porter in his laboratory, filled with all kinds of optical apparatus, telescopes completed and partly completed, testing equipment, and silvering materials, while a peculiar "kink" in the writer's mirror succumbed to Mr. Porter's skilled assistance, it being successfully fought to a finish after an afternoon's effort.

With Mr. Porter's articles, and especially his excellent illustrations and photographs (accurate pictures of the true appearance of a correctly parabolized mirror under the Foucault test have previously been almost unobtainable by the average beginner), and the equally striking drawings of telescope mountings which he has prepared for the next issue of the Scientific American—these, coupled with the book by the Reverend Mr. Ellison (maker of more than 130 mirrors), a book which covers telescope making in more detail than it could have been conveniently done in the Scientific American, and which is as requisite as any of the other working materials for the proper prosecution of the work briefly outlined at our request by Mr. Porter, make us sure that no such an opportunity to learn the art of mirror making has previously been presented to the amateur.

* * *

The World's Largest Passenger Locomotive

THE photograph of two locomotives of the Baltimore & Ohio Railroad, reproduced on this page, tells the story of the rapid growth of the locomotive in size and power during the present generation.

No. 1400, the smaller of the two, is by no means an antique. It presents none of those earmarks of age such as elaborate moldings on the steam dome and sandbox, which were considered the beauty marks of an up-to-date locomotive of the last generation. It is a standard, eight-wheel passenger engine of the type which hauled the crack express trains of not so long ago, and was a powerful engine in its time, with 20-inch by 24-inch cylinders, 1,500 square feet of heating surface, a rated tractive power of 19,800 pounds, and a total weight of 111,000 pounds without the tender. Including the tender, the weight is 201,400 pounds. It was an excellent engine and did its work effectively, until the increase in size and weight of passenger trains began to overtax its strength, and it became necessary to build larger engines to handle the larger trains.

It would take a book to describe the gradual growth of the locomotives of the Baltimore & Ohio Railroad from No. 1400 to the truly mammoth engine 5500 which is shown for comparison in the photograph; so we must be content to note the lines along which that growth has proceeded. Compared with European practice, American engineers have made it a point—the first point, in fact—to provide their locomotives with boilers of large capacity, and so to proportion the cylinders that the engine would be sure, at all times, of an abundant steam supply. Hence, we find that, whereas No. 1400 has a boiler whose greatest diameter is 62 inches, carries a steam pressure about 180 pounds, and has total heating surface of 1,500 square feet, the diameter of the boiler of No. 5500 is 100 inches, the steam pressure is 220 pounds and the total heating surface is 6,896 square feet. The cylinders have increased from 20 inches by 24 inches, to 30 inches by 30 inches; the weight of the engine alone from 111,000 pounds to 400,000; and the tractive power from 19,800 pounds to 65,000 pounds.

There follows a comparative table of the dimensions of the two locomotives:

	Locomotive of 1890	*Number 5500*
Cylinders	20″ x 24″	30″ x 30″
Valves	Slide	Piston
Clearance height	14′ 5½″	15′ 5¾″
Clearance width	8′ 10″	10′ 8″
Length	58′ 8″	100′ 6″
Driving journals	8″ x 8½″	11″ x 13″
Boiler diameter	62″	100″
Tubes, No. and diam.	194—2¼″	269—2¼″
Tubes, length	11′ 6½″	28′
Heating surface, total	1,500 sq. ft.	6,896 sq. ft.
Tender, coal capacity	8 tons	18 tons
Rated tractive power	19,800 lbs.	65,000 lbs.

This powerful engine can haul twelve passenger cars over the steep mountain grades of the Baltimore & Ohio system, thereby rendering the use of pusher or helper engines unnecessary.

bring the old set up to date ~

Any set that uses UV-199 or UV-201-A Radiotrons can be made to give better volume and quality, with one simple change—whether it is a home-made set or a manufactured set.

Simply substitute a new power Radiotron for the last tube. This requires only an inexpensive adapter, and a little extra current. And just ten minutes!

You won't know the old set after the change. No more rattles and blasts from driving the tubes beyond their power limit—but fuller tone and finer quality. One tube does it!

RADIOTRON UX-112
The new storage battery power Radiotron UX-112 may be used in sets that employ Radiotron UV-201-A.

RADIOTRON UX-120
The new dry battery power Radiotron UX-120 may be used in sets that employ Radiotron UV-199.

But always remember that the performance of your set depends on every single tube in it. Even one inferior tube can spoil the tone. Men who know this are always careful to get genuine RCA Radiotrons, to be sure of every tube in the set.

RADIO CORPORATION OF AMERICA
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Learning to Use Our Wings

Aircraft are being put to use in peace as well as in war. This department will keep our readers informed of the latest facts about airships and airplanes

Conducted by Alexander Klemin

In charge, Daniel Guggenheim School of Aeronautics

International News Reel

The Barling Bomber, the world's largest airplane, which required two and a half years to build, is to be relegated to the museum at McCook Field

Farewell to the Barling Bomber

IN the photograph is seen the *Barling Bomber* which cost the Army Air Service $400,000 and took two and a half years to build. It was the world's largest airplane.

Some technical data will be obtained when Lieutenant Macready makes a number of flight tests in this giant of the air, but beyond this technical data this monster airplane has contributed nothing to the advancement of the world's aviation. It will soon be relegated to the museum at McCook Field, Dayton, Ohio.

A Novel Sport Plane

IN the previous issue of the Scientific American, we predicted that the use of aerodynamically lifting struts in externally braced monoplanes would become more frequent than it has been in the past.

The *Wright-Bellanca*, by the use of lifting struts, certainly achieved remarkable results. Now the idea has been carried somewhat further in the Italian *Vittoria 1924* Sesquiplane, a novel type of sport plane of which two sketches are shown. In the first position, the struts provide all the necessary bracing for the monoplane wing, and at the same time, being cambered like the wing section, give lift themselves. In the second sketch, the struts are shown turned about a hinge. They now offer a large resistance to the air and can be used on the ground as a powerful brake.

The *Vittoria 1924* Sesquiplane, equipped with a 50 horsepower Anzani engine, has given a performance of well over 80 miles an hour. This new type of wing strut is certainly worth consideration.

Six Years of Air Transport

MAJOR GENERAL SIR SEFTON BRANCKER, as Director General of Civil Aviation, has had a unique opportunity for the first-hand study of commercial air transport. His paper before the Royal Aeronautical Society, summarizing six years of such experience, is therefore particularly valuable.

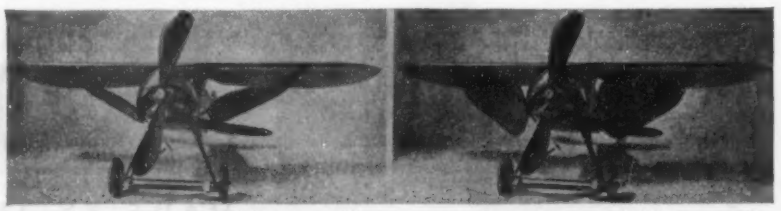
General Brancker is not only an administrator, but a skilled pilot with practical knowledge of every phase of aviation. His paper reviews air transport and sets off those things which are vitally necessary to its success.

The majority of accidents on the London-Paris route are associated with power plant failure. The General demands the provision of an infallible power plant even at the cost of extra weight and extra expense. Two and three engined ships may be helpful in securing power plant safety if it is found impossible to prove the reliability of a single-engined power plant. The pilot is too often blamed for accidents which are quite beyond his control, and at the same time his comfort is not studied as much as it should be. The pilot should be provided with a comfortable and well screened seat, a really good view ahead and all around, a slow landing, and, in the big multi-engined machine, the provision for an assistant.

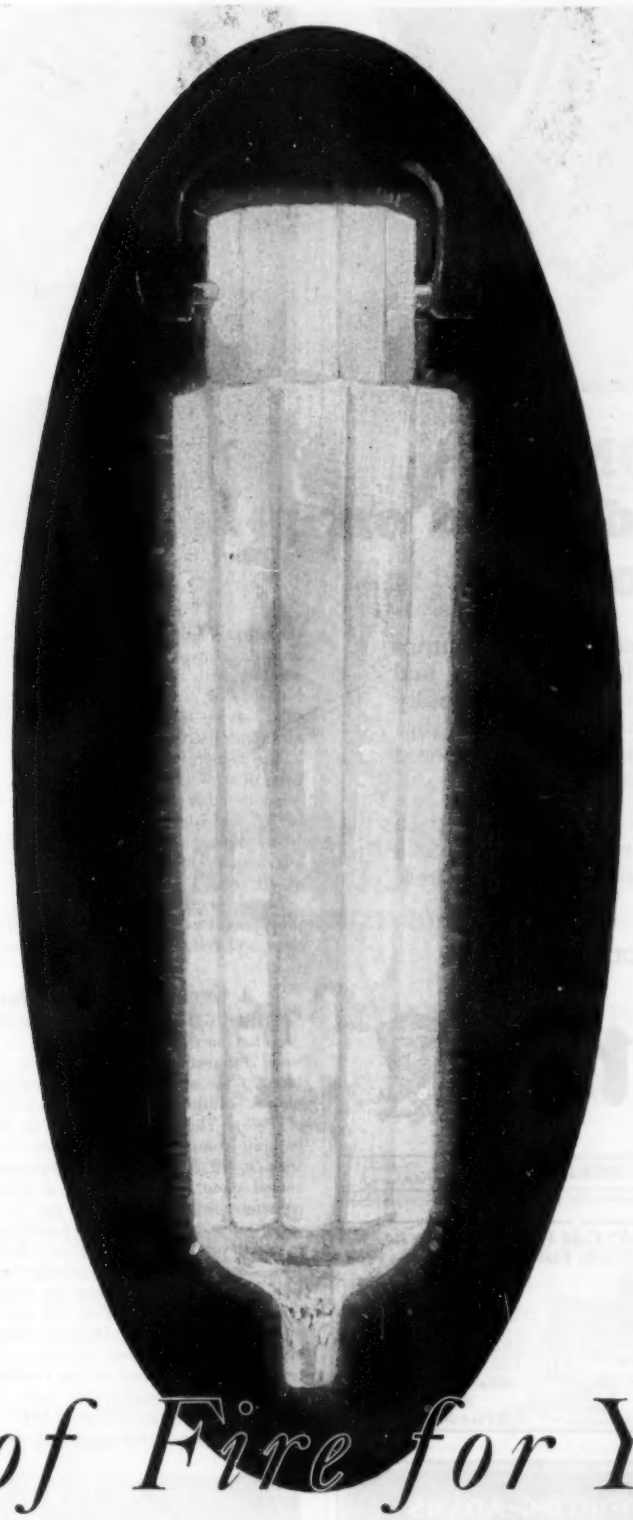
The sickness of a pilot in the air is very rare, but at the same time the provision of an assistant, who is capable of taking over all control when the pilot fails, is worthy of serious consideration.

At the moment that this is being written, news comes from London of a terrible fog covering the whole of England. Bad visibility seems to be the bugaboo of British aviation. With existing wireless equipment, it is possible to bring an aircraft easily over an airdrome in bad visibility. The British are experimenting with a view to being able to bring the airplane down even in the worst fog. The leader cable is used with satisfactory results; this being a cable made along

(*Continued on page 122*)



A model of the first, 1919-a, type *Vittoria* sport plane showing (left) the auxiliary wings in normal flying position, and (right) in airbrake position. This plane is equipped with a 50-horsepower engine



A Steel Ingot

Leaving Timken electric furnaces as a brilliant, boiling liquid, Timken steel is formed into these glowing ingots about six feet long. From the melt, to the ingot, to the finished bearings, every process is performed within the Timken plants.

Pillars of Fire for Your Car

Like blindingly bright water, liquid steel pours from the electric arcs of Timken furnaces, employing the highest heat known. Irresistible mechanical monsters "toss off" the searing steel, roll it, pummel it, squeeze it, and finally out come—not automobile frames, or engines, or axles, but—Timken Tapered Roller Bearings.

Relatively small in size, Timken Bearings require the largest electric steel output in the world! Timkens are produced on a scale so large, because of their large importance in cars and trucks, among other mechanical devices. Of all American makes, 83% use Timken Bearings, and Timkens are widely used in Europe as well.

Transmissions, differentials, pinions, worm gears, rear wheels, front wheels, steering pivots, and fans are Timken-equipped.

150,000,000 Timken Bearings have been built. There are Timken plants in the United States, Canada, England, and France. A daily capacity of 132,000 Timken Bearings is required.

Widest public acceptance must be based on engineering endorsement of Timken advantages—high capacity for bearing stress from all directions—exclusive positive roll alignment—special precision "cages"—the possibility of simplified design and reduced weight—and supremely enduring Timken-made steel.

To produce bearings which constantly improve the operation and economy of motor vehicles is an inescapable obligation of Timken facilities and resources, so great in extent.

THE TIMKEN ROLLER BEARING CO., CANTON, OHIO

TIMKEN *Tapered Roller* **BEARINGS**

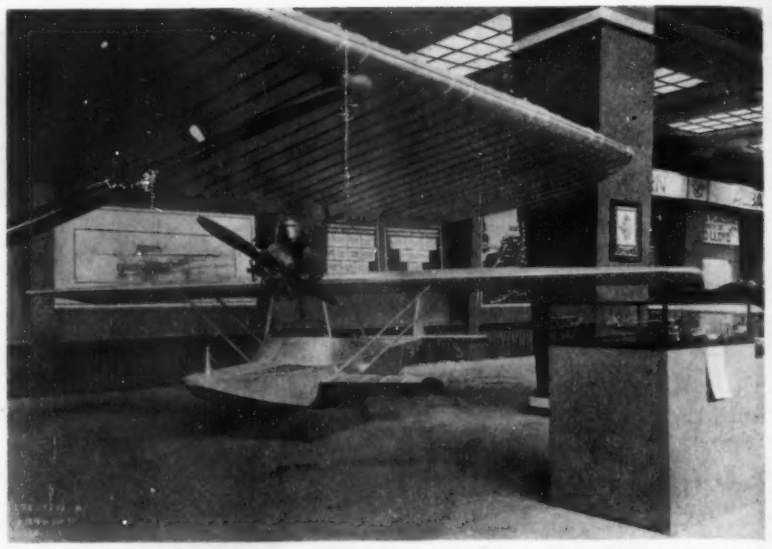


Figure 1: The Dornier *Dragonfly*, a small, two-seater flying boat, with the passenger and pilot seats behind the motor

the ground and carrying a current by which an aircraft may be guided by its pilot. This together with a line of Neon lights—electric bulbs filled with Neon gas—will show the pilot where to flatten out as he glides in accordance with the leader cable indications.

The General emphasizes very strongly the need of slow landing speeds. These may be secured either by an increase in wing area, or by such devices as flaps, slots, etc. It would appear that flaps and slots show great advantages and must be experimented with at all costs.

Metal construction is also demanded by the General as likely to give far more endurance and reliability than wood construction.

A German Aircraft Show

THROUGH the courtesy of the Editor of *Flugsport*, we are privileged to publish some interesting photographs of the very latest type of German airplanes and seaplanes, exhibited at the Münich exposition of 1925. The Dornier *Libelle* or *Dragonfly* is built completely of the alloy duralumin, with a 70 horsepower, seven-cylinder air-cooled motor. It can carry a pilot and a passenger with full load of gas at a speed of 90 miles per hour. The *Libelle*, contrary to usual practice, is a "tractor" flying boat, with the engine ahead of the occupants, who are thereby freed from the danger in a crash of the engine piling on top of pilot and passenger. The Dornier *Comet* is a six-passenger transport airplane, used extensively on the lines of the German Aero-Lloyd, with a comfortable and attractive looking cabin (Figure 3, page 124). One of our illustrations gives a general view of the exposition, showing in particular the small, low-powered "baby" planes for which German industry has gained such a reputation.

Not the least interesting exhibit at Münich is that of the Heinicke parachute. Unlike our own military pilots, who generally sit on a carefully folded chute, German aviators carry their parachutes on their backs. The illustration on page 126 shows how the pilot makes his exit. Sometimes the pilot's jump is much more hurried than the leisurely demonstration on the ground indicated in our picture. As the man clears the plane, the line still connected to the fuselage pulls the parachute out of its pack. This snaps quickly and the parachute gradually unfolds, bringing the aviator down to safety.

Four Liberty Motors on One Propeller

THE Handley Page *Hampstead* (shown on page 126), with its three engines, provides security against the failure of any one of them, but the plane as a whole is scarcely efficient because of the resistance of three large bodies breasting the air; namely, the central fuselage and the two outboard engine nacelles. An aerodynamically more efficient solution is the placing of the multiple engines together in the fuselage, geared to one propeller, with a mechanical system permitting the disengagement of a troublesome unit.

The Allison Engineering Company of Indianapolis has built such a power installation for the Army Air Service. It is described in *Aviation*. The transmission con-

(*Continued on page 124*)

Figure 2: The Dornier *Comet*, a six-passenger plane used extensively on the air lines of the German Aero-Lloyd

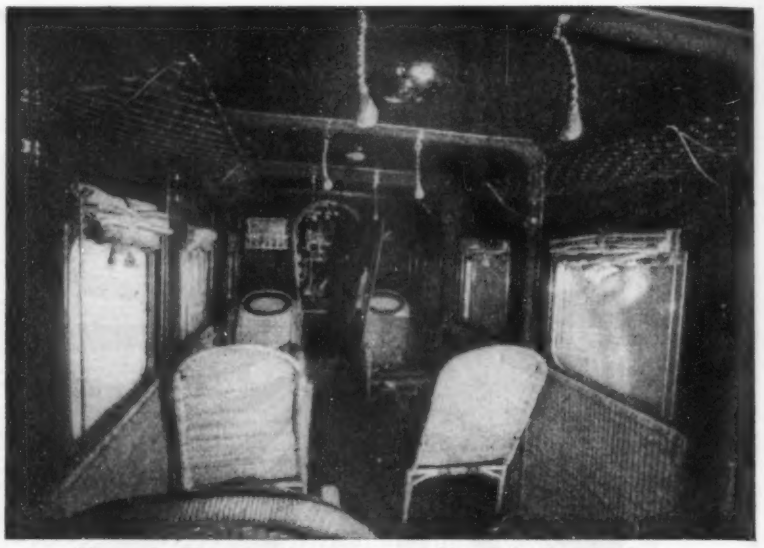


Figure 3: The attractive passenger cabin of the Dornier *Comet*

sists of a large rectangular cast aluminum case, carrying four driving pinions, one in each corner, grouped round a large spur gear on the propeller shaft. Each pinion is driven by a 400-horsepower Liberty motor through a sliding tooth clutch in such a manner that any engine may be thrown in or out of gear at will. The reduction in speed is from the 1,700 revolutions of the Liberty to 577 revolutions of the propeller, which in large slow planes should rotate slowly to be efficient. The transmission complete weighs only 875 pounds, yet it has stood up successfully to a fifty-hour endurance test. Every one has seen the mechanic with a piece of cotton waste in his hand, nursing the huge steam engines of an ocean liner. Now we shall have aero engine mechanic calmly working in an aerial engine room and making minor repairs on a temporarily disabled unit, while the huge plane continues to sail through the air at a hundred miles an hour!

Civil Aviation in Great Britain

AMERICAN commercial aviation neither receives nor seeks any form of direct government subsidy. But well-informed opinion in the United States is unanimous in demanding that Congress provide for some form of air regulation and for support in the construction of airports and airways. The 1925 British report gives an illuminating picture of the help which the Director of Civil Aviation is able to render English commercial flying along these lines.

On the skill and fitness of the pilot depend the safety of airplane and passengers alike. The pilot should not be merely an aerial chauffeur, but must have a thorough knowledge of his plane and engine, be a skilled navigator, capable of guiding his craft through fog and darkness, and be fit mentally and physically to meet any emergency. The careful system of examination and licensing adopted by the British has produced a class of aviators who have a training and a tradition comparable to the best officers of the merchant marine. The British Air Ministry has even established a system of periodical medical examinations which ensures that the pilot is at all times perfectly fit, and inspires the greatest confidence in the traveling public.

We are fortunate in the United States in having a far better "flying" climate than the British Isles and their surrounding waters. But even in the United States, fog is a great enemy of the pilot, and the 500,000,000-candlepower beacons of the Air Mail route across the continent fail to pierce fog. It is very encouraging to learn, therefore, that a new form of beacon, tested at the Croydon airdrome in London, is likely to solve the problem. This new light consists of a number of glass tubes filled with Neon gas which is made incandescent by passing through it a high-intensity electric current. The resultant rich glow enables aircraft to locate the airdrome under conditions of the worst visibility.

Had the *Shenandoah* on its last flight been supported by an adequate meteorological service, the disaster would certainly have been avoided. In Great Britain all the

Figure 4: A general view of the Münich exposition, showing many of the well-known, German, low-powered planes

How a German parachute jumper makes his exit from a plane

meteorological services of the nation are under the control of the Director of Civil Aviation and pilots on the lines from London to the continent receive instant warning by wireless of any dangerous weather ahead.

The work of the Air Ministry is not restricted to these auxiliary services, however valuable. Equal encouragement is given to the improvement of the airplane itself for passenger carrying purposes. It is not always possible for the American manufacturer, although he does not lack the necessary skill, to make the large investment necessary for a giant airliner. The Air Ministry places orders with private constructors for experimental machines of this type and then puts them at the disposal of the subsidized Imperial Airways for extended test. The system is productive of much progress.

Even on a flight of a few hours, it is an ordeal to sit in a stuffy cabin if half the passengers are suffering the pangs of air sickness. Accordingly, the British are experimenting with ventilating systems, with large scoops outside the fuselage not unlike the ventilators of a sea-going vessel, and reducing the discomforts of travel greatly thereby.

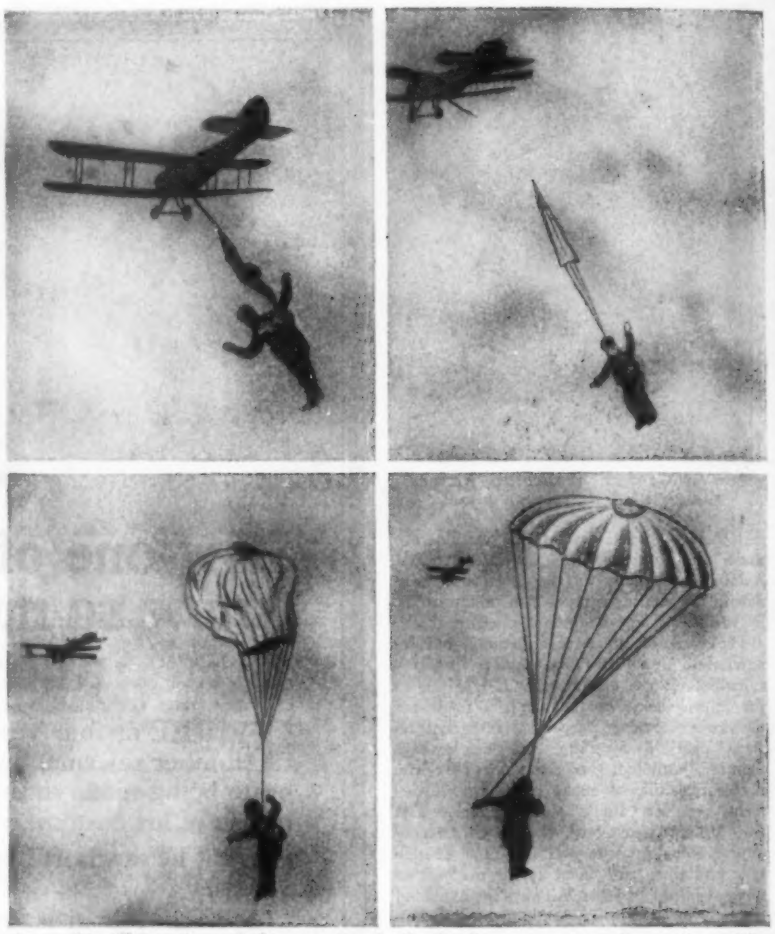
The airplane has now reached a point where its structure is perfectly satisfactory. But power-plant failure still remains to be conquered.

Government support is enabling the British to build huge passenger carrying planes with three engines, capable of flying on any two of the three. An example of this type of plane is shown in our photograph of the Handley Page *Hampstead* which is equipped with three air-cooled "Jaguar" engines of 385 horsepower each. The *Hampstead* provides accommodation for 14 passengers in a Pullman saloon and has a top speed of 116 miles per hour. Not only can this plane fly horizontally on any two of its engines, but it can actually climb 220 feet a minute with one motor completely dead. Such a multi-unit power plant secures a safety which more than compensates for the smaller efficiency of a three-engined plane as compared with a single-engined one.

Still another significant tendency in British air work is the discarding of the water-cooled engine with its burdensome weight of water and radiator, in favor of the simpler and lighter air-cooled power plant.

A Delightful Sport

PERHAPS the value of gliding as a means of obtaining scientific data has been overrated. But it remains a delightful sport. It has not taken deep root in the United States, however; perhaps because the American young man demands the thrill of a powerful internal combustion engine, or perhaps because no such favorable meteorological conditions as exist in certain parts of Germany have been located on this side of the Atlantic. At any rate, gliding is an uncommon sight for most of us. Our readers may therefore be interested in a series of photographs received from Germany.



A graphic illustration of the way in which the German aviator leaps from his plane. The line connected to the fuselage pulls out the parachute from the pack, snaps and allows the parachute to unfold. Once open, the parachute fills with air and brings the aviator floating down to the ground in safety

For the start the glider pilot must have speed, and he has no power on board his craft to secure this speed. One of our photographs (on page 127) shows him utilizing a motorcycle to pull the glider along the ground until the necessary speed is secured. When sufficient speed has been obtained the pilot pulls a lever and releases the hook, clearly visible in Figure 2. He is dependent henceforth on his own resources. It will be noted that the pilot is strapped to his seat and that in this particular glider he maintains the equilibrium of his craft with only one hand clutching the control or "joy stick," the other hand grasping firmly the strut immediately in front of his seat.

A convenient motorcycle is not always available, and in Figure 3 the group of husky young men have evidently been pulling hard on the towing rope now slackening in their hand after release by the pilot. Incidentally Figures 2 and 3 illustrate the simple construction of a typical glider. The pilot's seat is placed in the open on top of a skid. A simple system of two booms and diagonals supports the tail surfaces, with a few wires for additional bracing.

When the glider is once aloft nothing can equal the sensation of ease and mastery which is experienced by the pilot of one of these gliders.

Why glide on a hillside, it may be asked, since the motorcycle or husky young men are utilized for the initial impulse? Because on the side of a hill may be found that upward circulation of air rising to the crest of the hill, without which the glider, no matter how skilfully maneuvered, must soon come to earth. But given the right location and a favorable steady up-wind, the glider can stay up indefinitely.

The Automobile Airplane

AN airplane that could return on its own power from the flying field to a garage in the city is a plausible and fascinating idea. The ordinary plane might conceivably undertake such a trip, but the spread of wings would be uncomfortable in traffic to say the least, the tail skid would not improve the roads, and the powerful airplane engine would not be suited for slow driving through crowded streets.

Our Paris correspondent sends us a description of an interesting combination of automobile-airplane designed by M. René

Wide World

The huge Handley Page *Hampstead* with three air-cooled engines. With a full load of fourteen passengers and fuel for several hours' flight, this giant of the air can fly indefinitely on any two of its three power units. This gives a great measure of security against motor failure in the air

Kadel & Herbert

Figure 1: Using a motorcycle to tow a glider up to speed for the start

Tampier, which seems to overcome these difficulties. At any rate M. Tampier has driven this strange vehicle through the streets of Paris and then flown from one of the big flying fields, without any trouble other than about thirty minutes' work in readjusting the landing gear and setting the wings in flying position.

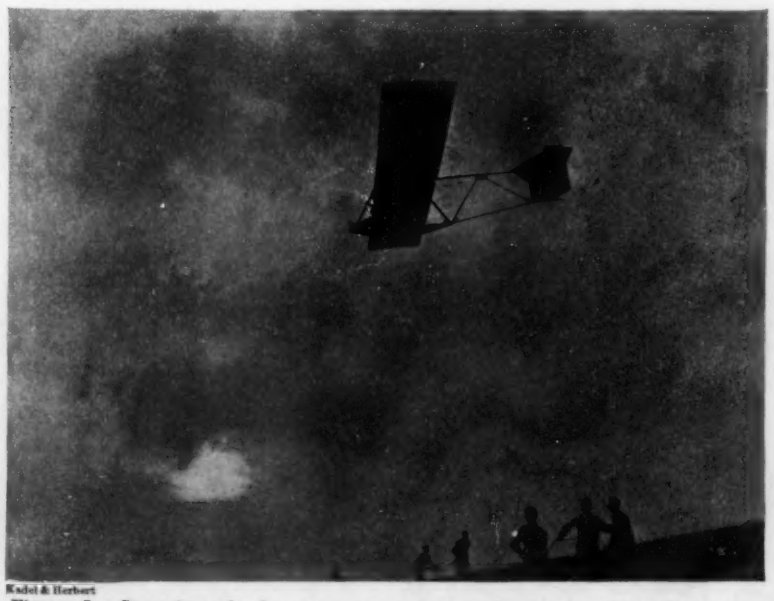
of page 128) through a bevel gear drive to the axle of the main landing gear. On landing, the wings are folded back parallel to the fuselage by unfastening a pin or two, an extra set of wheels is attached to the rear part of the fuselage and the plane becomes a convenient motor car.

The auxiliary motor aside from running

Kadel & Herbert

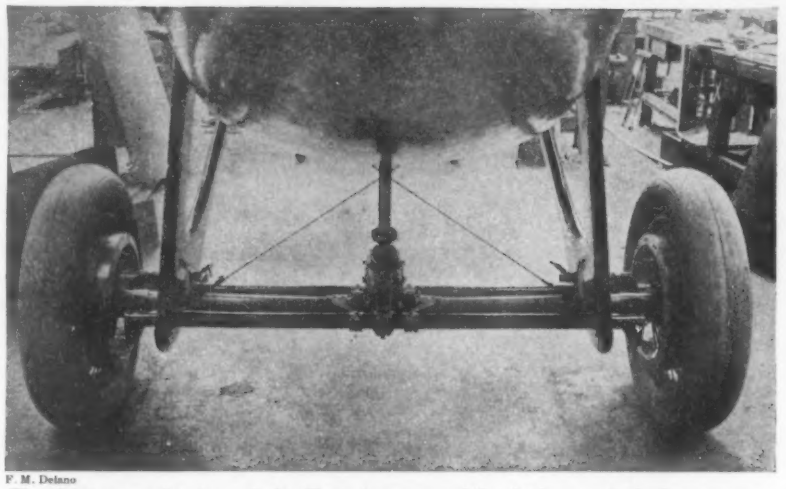
Figure 2: Flying speed obtained, the pilot releases his towing rope by a lever

In this combination type of craft an auxiliary motor is set just behind the main flying motor. The auxiliary motor is connected by a perpendicular shaft (as shown at the top the land running gear, can be used as a starter or as a prime mover for the lighting motor in the air, so that it is not useless even in the air.



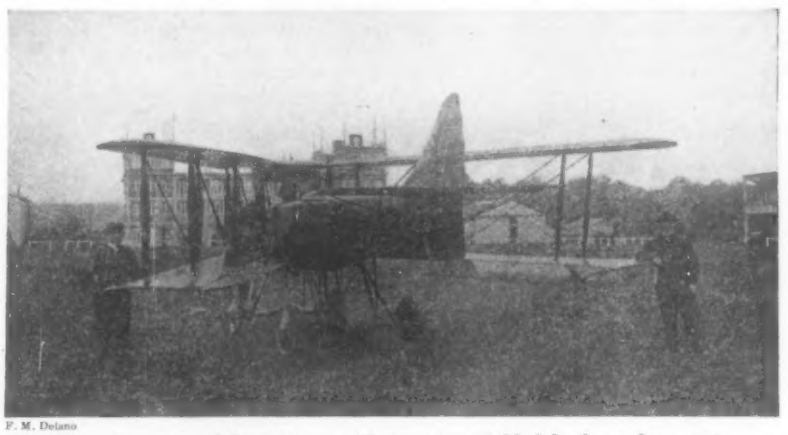
Kadel & Herbert

Figure 3: Sometimes husky young men replace the motorcycle. The towing rope is slackening in their hands after release by the pilot



F. M. Delano

The driving mechanism of the Tampier automobile-airplane. A shaft runs perpendicularly from an auxiliary motor placed in back of the main flying motor. This shaft drives the axle on the ground through a bevel gear



F. M. Delano

The Tampier automobile-airplane with its wings folded back, and an extra set of wheels attached to the rear part of the fuselage. In this position it is ready to negotiate city traffic. It is a matter of about thirty minutes' work to readjust the landing gear and set the wings in flying position

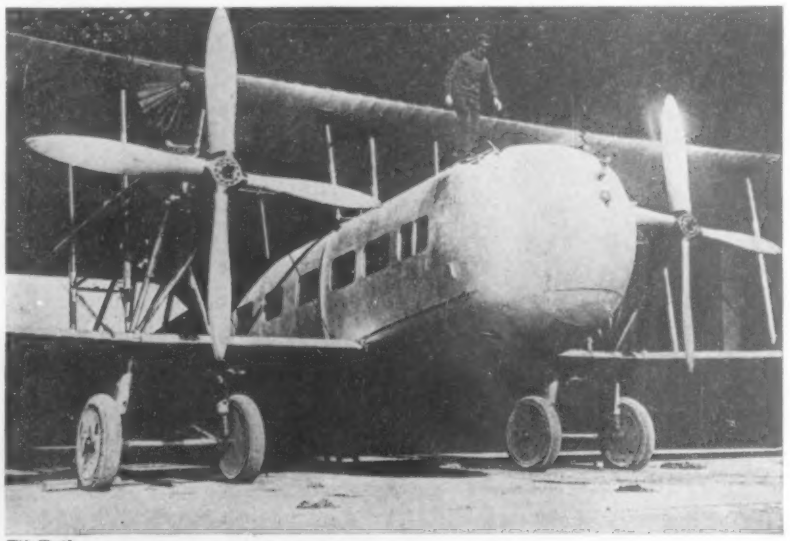
American Engines Are Conceded to Be Supreme

WHILE America may lag in the construction of large passenger carrying planes, there is no doubt that in the aero engine field, it surpasses all foreign practice. An English plane manufacturer is actually buying large quantities of Curtiss D-12 engines.

These engines helped to win the Schneider Cup for the United States in 1923 and to secure the great speeds of the Pulitzer racers in 1923 and 1924.

The Vickers Two-Engined "Vanguard"

SOME designers and pilots claim that even a two-engined plane gives a measure of safety against engine failure. At any rate, British constructors are building very large two-engined passenger planes. The Vickers *Vanguard*, equipped with two powerful Rolls-Royce motors is an interesting example. It can carry twenty-two passengers in comfort; there are even arrangements for serving meals during flight, a small table being fitted in front of each seat.



Wide World

The Vickers *Vanguard*, equipped with two Rolls-Royce engines, one of the largest passenger planes in the world. It is capable of seating twenty-six passengers, with small tables fitted in front of each seat. Note the fine, rounded lines of the fuselage. Four-bladed propellers are used, because with a two-bladed propeller the diameter would become cumbersomely large

Science and Money

Real Estate Mortgages

By Henry C. Trundle

TAKING the country as a whole, 42 per cent of the homes occupied by owners are mortgaged, says W. J. Moore, president of one of the large bond and mortgage companies. The percentage averages 56 per cent in New York and adjacent States, which, incidentally, are among the richest in the Union. Instead of indicating a lack of prosperity or extravagance on the part of our home owners, this mortgaging of property means that our best citizens are utilizing the resources at hand to give them more working capital.

Mortgages Are Popular

A Brooklyn appraiser relates that over a period of five years in inspecting properties for loans he has come upon but one home which was unmortgaged. This property was at the time unencumbered because the mortgage had just been paid off as a wedding present; the young couple was quick to remortgage it.

Very few of the homes in a large city and an even less number of large office buildings, hotels and corporate undertakings are without a mortgage upon them. Were it not for this privilege many persons of moderate means would be tenants and huge structures would never be erected because of the inability of interested individuals to finance them.

Real estate mortgages are known to have been made by the Babylonians as early as four thousand years ago. Probably before and certainly since then, and in every country, land and the buildings upon it have been accepted as security for an indebtedness. The excellent security of land is evident for it is a fixed and tangible article. Man requires soil to till and live upon and besides actual sustenance his chief want is for shelter. Land and buildings are, therefore, always in demand wherever there is habitation.

Safety Is the First Principle

Safety of principal and interest, the first consideration of every investor, has become recognized as the accepted feature of investments secured by real estate mortgages issued under proper conditions. Investment offerings having behind them the credit of nations, world known industrials or transcontinental railroad systems, have at times had their values seriously impaired, with subsequent loss to the purchasers; but real estate mortgage concerns boast (sometimes unduly) of their records of years without loss to their customers. Such mortgages are, and have always been, popular with investors of every size and the reasons are not hard to find.

The subject of real estate mortgages falls naturally into two divisions (a) as affecting the borrower (b) as affecting the lender or investor.

Borrowers who pledge their real property as security for a loan are chiefly (1) home builders, farmers and small buyers who want eventually to own their own property and who need credit on convenient terms; (2) builders who need capital for the large building operations; (3) operators and investors who find it profitable to use other people's money in addition to their own, so as to obtain a larger return on their own capital; (4) promoters or developers who undertake to convert large waste areas into productive enterprises and (5) corporations who construct and operate large properties such as office buildings, terminals, warehouses, hotels, amusement centers and similar propositions beyond the scope of individual enterprise.

Why should a person mortgage his property to obtain money to reinvest? Why go into debt and have the trouble of collecting monies due him and of paying monies due another? Would it not be more convenient and just as profitable to live on one's property free of debt? These are questions which are frequently asked, and their answers are simple.

First, there is the individual who borrows on his property at 6 percent because he can obtain 8, 10, 15 percent or more upon the money thus received by investing it in his business or in a venture of some sort. Secondly, there may be a vacant lot or small building, the income from which is insufficient to pay taxes or provide a net profit. Additional capital invested in the project may enable it to be fully productive. Real estate buyers have often had their investment in non-productive or unimproved land wiped out entirely through taxes, without mentioning loss of interest, before appreciation in value was sufficient for a profitable sale. Improvements in the nature of buildings or otherwise may turn an unfortunate investment into a decidedly profitable one. Hence, one borrows.

How Is a Loan Arranged?

Having found it necessary to borrow or having decided to do so, how is a loan arranged? Size, perhaps, dictates the method. Familiar, of course, is the small town banker who knows intimately both property and borrower. The services of an acceptable lawyer complete the deal. In the large communities will be found mortgage companies which maintain appraisal, legal and selling experts. Building and loan associations, organized under state laws, provide a convenient means to borrow. Large loans, usually upon well known properties, are obtained from investment bankers and in turn sold by them in the same way as corporation or government securities.

Farmers who at times have found it difficult to borrow upon their property are now aided through the Federal Farm Loan Act which provides capital for agricultural development, creates standard forms of investment based upon farm mortgages, and equalizes rates of interest upon farm loans. Such loans are secured by first mortgages, must be paid off within from 5 to 40 years, must be used to extinguish pre-existing indebtedness or for productive purposes, and the rate of interest cannot exceed 6 percent per annum. This act has contributed largely to the current prosperity of our western farmers who had found their credit entirely "frozen."

Mortgages Are Sound Investments

Insurance companies are known to be large purchasers of real estate mortgages; for every dealer in them emphasizes the fact that conservative insurance companies have taken a sizeable block of the loan under consideration, or at least that they are buyers of mortgages of a like character. Perhaps it is not so generally known that insurance companies themselves make many loans secured by mortgages.

Having considered the mortgage business from the standpoint of a borrower, let us view it as a lender upon or an investor in mortgages. Quite naturally there have come to be innumerable concerns and individuals whose business it is to loan upon mortgages and in turn to offer them as possible investments to others who have surplus funds seeking safe and profitable employment. When the amount of a proposed loan is beyond the individual capacity to lend, it is inevitable that the loan must be obtained from professional underwriters. It is these companies that will next be discussed.

In many cities there are mortgage companies and title companies which offer guaranteed mortgages. Some loan on improved property only, while others loan on both improved and unimproved property. These mortgages usually run for three years, and

at maturity the investor can ask for payment of the loan, although the majority are extended. As these loans are offered for sale to the public with payment of principal and interest fully guaranteed, the rate of interest to the investor is usually one-half of 1 percent less than the rate named in the mortgage, this difference of one-half of 1 percent being the premium charged by the company for its guarantee. The company pays the interest when due, whether it has collected it or not. The principal is paid at maturity if desired; but in order to protect itself against the necessity of paying guarantees at a period of financial stress, some provision is made to withhold payment for a certain number of months, so that there will be sufficient time to collect from the owner of the property.

Some mortgage companies for the payment of the small fee of one-half of 1 percent will take over a mortgage held by a private individual and guarantee payment of principal and interest. The company collects the interest, sees that taxes, assessments and insurance are promptly paid, and safeguards the security itself by periodic inspection of the property, thus relieving the investor of such responsibilities. For so small a sum the investor can obtain the full co-operation of experts in mortgage lending in the supervision of his own loan.

As an outgrowth of the title guarantee business, associated companies have been formed to deal in mortgages. One such organization has had sales amounting to over one billion dollars in the more than forty years of its existence. Not only has this company provided an investment in convenient amounts for its customers, but it has aided as well the small borrower. It has been the general policy to lend upon homes and small land holdings and during its life the company has guaranteed more than 120,000 mortgages.

Underlying Guarantees Are Important

The question of the adequacy of a company's assets to meet the liability of the mortgages it guarantees is one that is constantly raised. It is often forgotten that such companies are in effect insurance companies and that their insurance business is conducted at proper rates. Other types of insurance and casualty companies are continually paying losses; these losses are understood to be a normal part of their business. Real estate mortgage losses are so infrequent—said by one guarantee company to be less than one-tenth of 1 percent of its guarantees—that it can be seen that this type of underwriting is a safe proposition for the company, and likewise that it provides a sufficient element of strength for the investor.

Purchasers of guaranteed mortgages therefore, have behind their investment, the property securing the loan, the assets of the guaranteeing company and also the personal bond of the borrower.

Another type of real estate mortgage dealer is one which concerns itself only with propositions running into hundreds of thousands and millions of dollars. Loans may be made upon fully constructed and tenanted properties or for construction purposes. The former loans are not so intricate and are generally easily marketed. Building loans require a great deal of expert opinion; and it is a testimony to the integrity and careful judgment of our great mortgage houses that they have been consistently successful in their business. The great real estate developments have been made possible through their courage in undertaking them and the public's confidence in financing them.

The interests of the investor in the bonds issued by a company offering this type of business are safeguarded by these principles:

(1) Each bond issue must be a first mortgage on improved, income-producing real estate of the best class.
(2) The property must be well located and thoroughly suited to the rental demand of its neighborhood.
(3) Income must be sufficient to pay interest and to amortize the principal.

It should be noted that payment of principal and interest is not guaranteed, although the advertising slogan of one company is that for over two score years no investor has suffered a loss. Before any bonds are sold a title insurance company has investigated the borrower's title to the property; and if everything is satisfactory, a guarantee company issues a policy covering the whole bond issue. The object of this is to substitute a guaranty for an opinion in regard to the validity of titles to real estate. All the legal details are passed upon by skilled lawyers, and a competent trust company is usually appointed trustee to see that the provisions of the trust deed are properly complied with.

Recognizing the unexcelled investment qualities inherent in real estate mortgage bonds, banking firms which previously had concerned themselves strictly with corporation or government securities, have now gone into this type of financing. These bankers, however, ordinarily are interested only in the very large issues. The bonds are marketed in exactly the same manner as any corporate security, which means that they are distributed by the originating house, through all of its branches, and by other firms which are associated with it in a syndicate formed to dispose of the issue.

So far in this article we have had in mind only first mortgages. Of course there are any number of varieties of mortgages junior in lien. The price at which they are offered to investors is commensurate with the risk. Such mortgages lean to the speculative and should be purchased only after careful consideration and with full knowledge of their risks.

The precise names of common forms of real estate mortgage offerings are mortgages, participating mortgages and bonds. A mortgage as a vehicle of public financing is suitable only in the case of relatively small loans. Where two or more persons desire to share in a loan, a mortgage is made to a trustee who will issue a certificate of ownership to each person having an interest in it. The major part of real estate financing is done by means of bonds issued against the actual mortgages which are held by the lender or deposited with a trustee. Still another form is the collateral trust real estate bond, which is the obligation of the mortgage company secured by deposit with the trustee of mortgages of various amounts. If the company is a sound one such bonds should be safe.

Mutual Profit Mortgages Now Available

A new type of junior real estate security is offered by a company which sells the preferred stock of a corporation formed to own and operate a property, which is usually a well located office building that has been planned and built by the same interests in associated capacities. A mortgage, amounting to about 50 percent, is placed upon the property and a loan secured elsewhere, the balance being obtained through the sale of stock. Each share of preferred is accompanied by two shares of common, one of which goes to the purchaser of the preferred and the other to the security company. It is the plan to pay preferred dividends and to retire the principal within a period of ten years. Thereafter the investor shares equally with the security company in all net profits through the ownership of the common stock. This type of security is gaining in popularity and undoubtedly is of especial interest to those who rent in such properties and who believe that huge profits accrue to the owners. Its speculative nature should be remembered.

If real estate first mortgages are so prime an investment, what is the explanation that they are offered at varying prices yielding from 5½ to 7 percent, more or less? It has been a custom of the business to sell mortgages and mortgage bonds at par or 100, the interest rate corresponding to the normal rate of interest. This, at times, has worked a hardship upon mortgage dealers who have found it difficult to maintain their prices at 100, when other classes of security

have been offered at much lower prices due to economic conditions. Investment houses, as ordinarily understood, on the other hand, have considered that real estate mortgage bonds should be marketed on the same basis as any other security. Prices for that reason have been subject to market fluctuations and vary from time to time. Short term issues are high priced, while the longer maturities are moderately priced.

The chief objection to real estate mortgage bonds has been that they are not readily marketable. Many investors prefer to have their entire funds in securities that can be liquidated immediately and without loss. Mortgage concerns attempt to meet this requirement by repurchasing bonds at a price only one or two points lower than the offering price. When they believe the bonds are offered for repurchase so that another investment may be made, they make a nominal bid sufficiently low to discourage the sale.

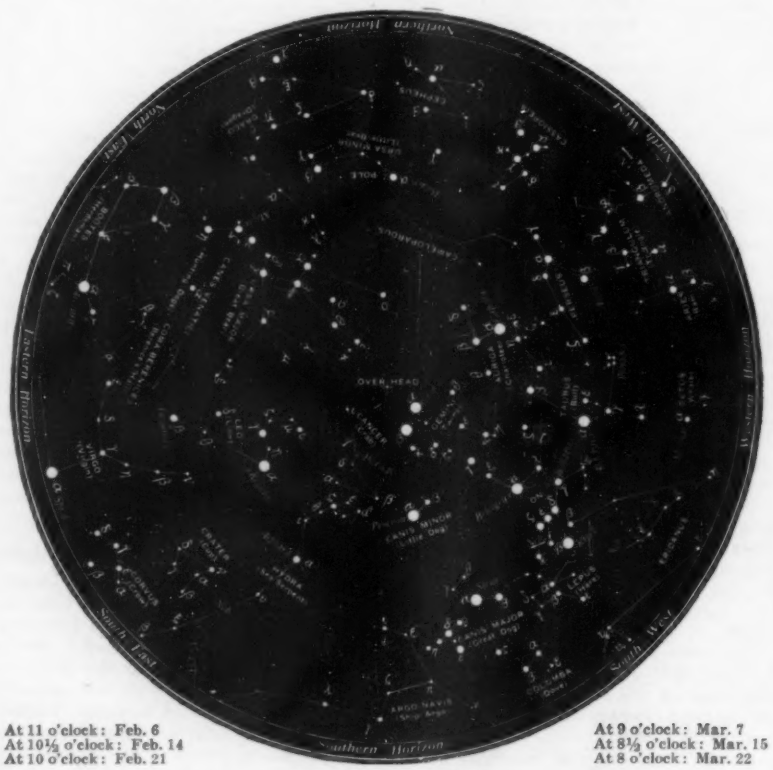
Guaranteed mortgages are likewise repurchased in necessary instances on a satisfactory basis. Investment houses which maintain a market for their real estate bonds do so with the usual spread of 1 or 2 points. It is interesting in discussing marketability to note that disinterested security dealers or brokers are trading more and more in the larger issues of certain real estate mortgage concerns and that an outside market is rapidly being built up.

Because the future success of real estate mortgage houses is dependent upon past records, each house considers itself under obligations to its customers until every dollar of principal and interest has been paid. Some insure principal and interest through associate companies; others have the mortgages guaranteed by casualty companies doing a general insurance business. In all cases every precaution is taken that the monies invested in their offerings are safe and the interest and principal promptly paid.

Just which is the strongest financing is anybody's guess; but it is evident that the investor in real estate mortgages would do well to give careful study to any proposed investments. George E. Roberts, Vice-President of the National City Bank, and an authoritative writer upon economic conditions, says "the building boom is going too strong to last." This statement indicates that the wisest cours is to deal only with responsible houses.

The Heavens in February

By Professor Henry Norris Russell, Ph.D.



At 11 o'clock: Feb. 6
At 10½ o'clock: Feb. 14
At 10 o'clock: Feb. 21

At 9 o'clock: Mar. 7
At 8½ o'clock: Mar. 15
At 8 o'clock: Mar. 22

At 9½ o'clock: March 1

NIGHT SKY: FEBRUARY AND MARCH

The Heavens

THE southwestern sky is now at its best. Orion, the Great and Little Dogs, Taurus, and Gemini are all within this quarter of the sky, and Auriga is only just outside of it. The northwest, with Perseus, Andromeda and Cassiopeia, is less brilliant. Draco and Ursa Minor are low in the north and Ursa Major high in the northeast, with Bootes rising below. Leo and Virgo are in the east, while Hydra is the most notable constellation in the dull southeast.

The Planets

Mercury is in conjunction with the sun, and behind him, on the 15th, and is invisible all the month. Venus is also in conjunction on the 7th, and in front of the sun. Before the end of February she comes out as a morning star, and on the 28th she rises before 5 A.M. and is conspicuous. Mars is a morning star in Sagittarius and rises at 4:10 A.M. in the middle of the month. Jupiter is also a morning star, but much nearer the sun. On the 17th, he is in conjunction with Venus, and both planets may be seen in the dawn—nearly ten degrees apart.

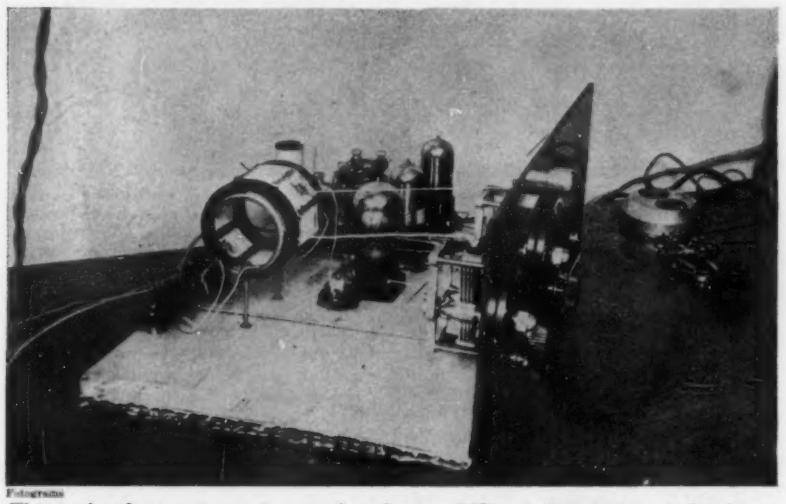
Saturn is in quadrature, west of the sun, on the 15th, rises at 1 A.M. and is observable in the morning hours. Uranus is in Pisces and sets about 8 P.M. Neptune is in opposition on the 12th—being then in Leo in 9 hours 43 minutes R. A. and 14 degrees, 3 minutes north declination, but is visible only with a telescope.

The moon is in her last quarter at 6 P.M. on the 5th, new at noon on the 12th, in her first quarter at 8 A.M. on the 19th, and full at noon on the 27th. She is nearest the earth on the 12th and farthest off on the 25th. During the month she passes near Saturn on the 6th, Mars on the 9th, Jupiter on the 11th, Venus and Mercury on the 12th, Uranus on the 14th and Neptune on the 26th.

Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Conducted by Orrin E. Dunlap, Jr.



Fotogramo

This is the short-wave receiver used at Station 2CV. A description of this long-range amateur equipment is contained in these columns

Brooklyn Boys Talk with Australia

Two Brooklyn boys have built an amateur station, recorded in the Government's call book as 2CV, in order that they might experiment with short waves and make friends with amateurs in other countries. The operators, Irving Korenman and Frank D. Manz, have carried on two-way communication with three amateurs in Australia, two in New Zealand, others in Samoa, Hawaii, Chile, the Argentine, three countries in Europe and in forty-three States. They also talked with the U. S. destroyer *Scorpion*, anchored in Trieste Harbor, Italy.

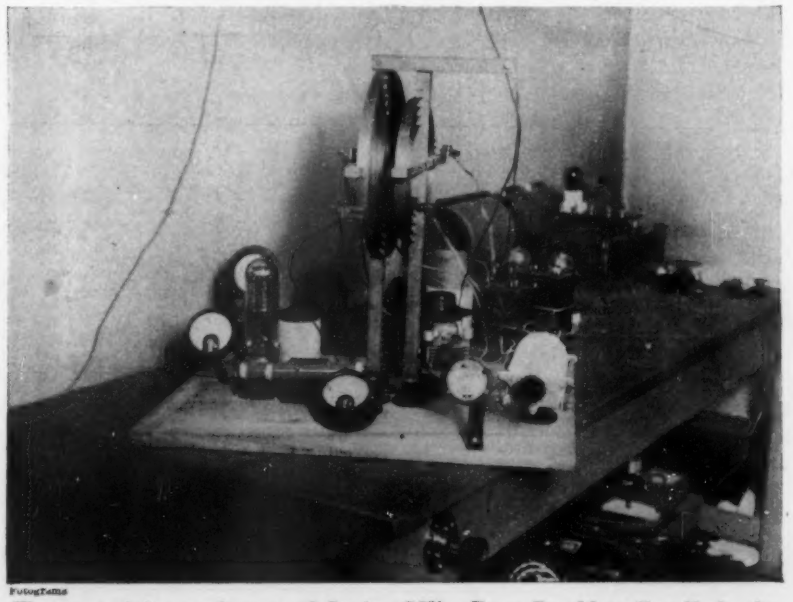
One morning, at 5:40 o'clock, one of the operators was tuning around the dials of the 39-meter Reinartz three-tube receiver when he picked up the signals of the U.S.S. *Seattle*. He started the transmitter and called the ship and communication was immediately established over the span of 2,200 miles; for the ship was 400 miles northwest of Balboa. The Navy operator requested press and the amateur asked him to QRX—stand-by—until he ran out to the newsstand on the corner to get a morning newspaper. Daylight was gaining in strength and aware of the light's effect on low waves the boy hurried. When he reached his station he found the vessel still standing-by on the 39-meter channel and he broadcast 1,500 words of the morning news.

The waves were intercepted by the three-tube set in connection with a small antenna strung around the molding of the room. The wiring diagrams and photographs of the simple receiver and transmitter are published on this page. They will undoubtedly be of interest to hundreds of radio experimenters. The following specifications apply to the diagrams:

The transmitting aerial is a single wire 35 feet long and the ground is a counterpoise, built as a duplicate of the aerial and underneath it, a few feet off the ground. The receiving antenna is an indoor affair, consisting of a copper ribbon 20 feet long strung around the molding of the room. The counterpoise, or ground, used for receiving is 15 feet of wire laid on the floor below the antenna.

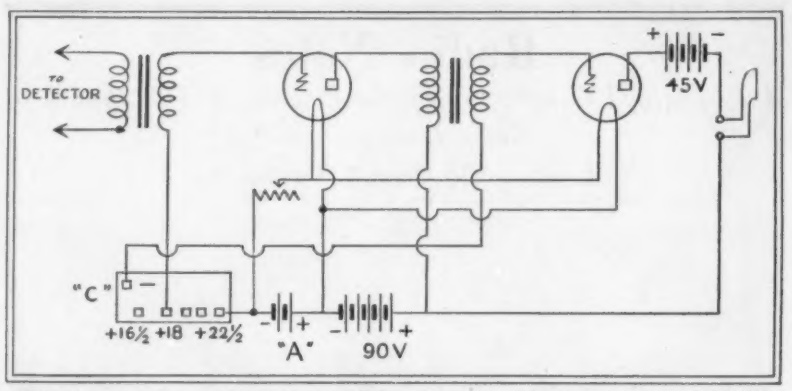
The detector is a UV-201-A with the metal base removed to minimize capacity effects which would have a detrimental effect upon short waves. Simplicity is the keynote of success in short-wave transmission and reception. A standard two-stage audio amplifier is used.

In the receiver, diagram "A" is five turns of No. 16 D.C.C. (double cotton cover)



Fotogramo

The transmitting equipment of Station 2CV. From Brooklyn, New York, the amateur operators of this station have talked with the U. S. Destroyer *Scorpion*, anchored in Trieste Harbor, Italy



This diagram shows the audio amplifier circuit as wired for the new UX-120 power amplifier tube. If a UX-socket is used this diagram should be followed. The UX-tube will not fit the ordinary socket unless an adapter is employed. When the adapter is used no change in wiring is required in the average set, as connections for the extra 22½-volt "C" battery and 45-volt "B" battery are provided on the adapter

wire, wound as a self-supporting coil. It is loosely coupled to the secondary. Coil "BCD" is also self-supporting. That is, it is not wound on a tube or permanent frame. "BCD" is tapped as illustrated; "B" has four turns of No. 16 D.C.C. wire; "C," nine turns and "D," four turns of the same size wire. V1 is a three-plate variable condenser; V2 is .000125 mfd. capacity and it controls regeneration. C1 is an .0002 mfd. grid condenser and 9 megohm grid leak. I is a radio frequency choke coil of 150 turns of No. 30 S.C.C. (single cotton cover) wire, wound on a tube one inch in diameter.

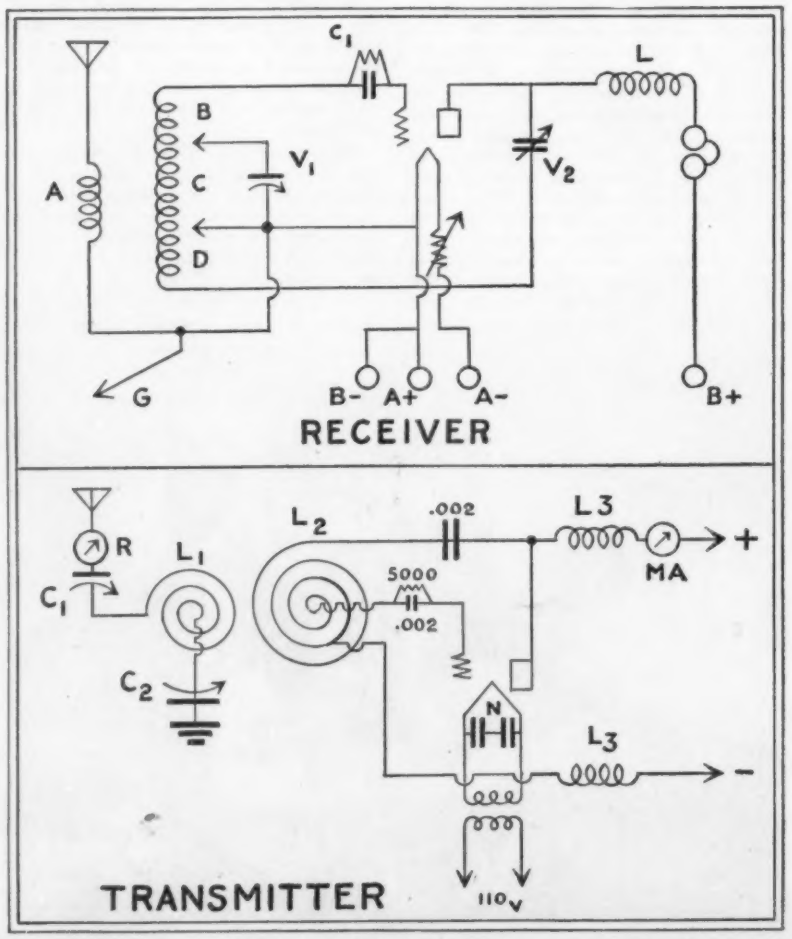
The transmitter is a loose coupled Hartley circuit. The high voltage is derived from a step-up transformer delivering 1,500 volts to an "S" tube rectifier system and a filter system consisting of a 30-henry choke coil and a 6 mfd. filter condenser. In the transmitter diagram, "R" is a radiation meter; L1 is a pancake coil of five turns of one-half inch brass ribbon L2 is a pancake coil of nine turns of one-half inch brass ribbon. C1 and C2 are variable condensers of .00025 mfd. capacity. L3 is a radio frequency choke of 150 turns of No. 26 D.C.C. wire wound on a glass tumbler. "MA" is a milliammeter. "N" represents two fixed condensers each 1 mfd. capacity.

Ten Million in Advertising

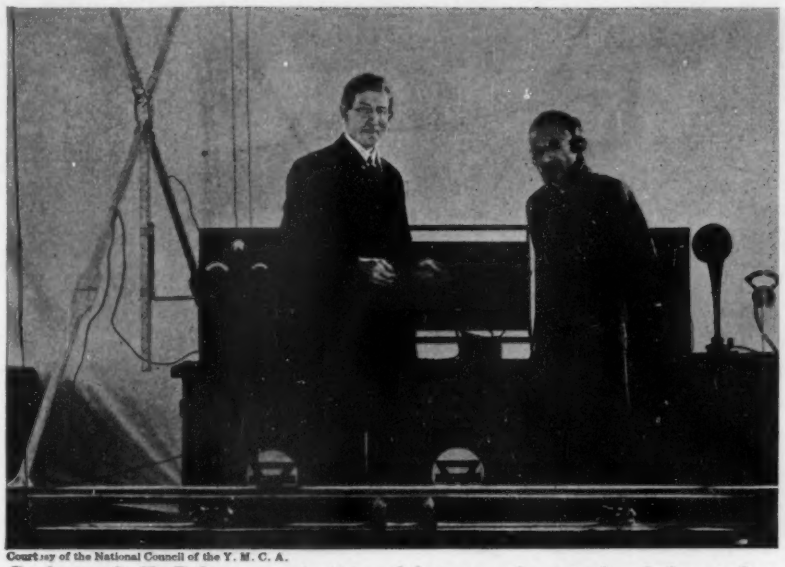
THE radio industry will invest $10,000,000 in advertising this season, according to the estimate of an investigator reported to the Bureau of Advertising of the American Newspaper Publishers' Association. Of this sum, it is figured $2,500,000 will go to newspapers.

Listeners Report on Super-power

SINCE the first super-power tests made by WGY, Schenectady, using a 50-kilowatt transmitter, thousands of reports regarding reception have been received at the station. Not all of them are favorable but by taking averages, we have a fair impression of what listeners think of high powered waves. Of all letters received, 81 percent reported that the signals were twice as loud; 64 percent



The wiring diagrams of low-wave station 2CV. This station, owned and operated by two Brooklyn boys, has talked with many foreign countries and with American ships abroad. The hook-ups are explained above



Courtesy of the National Council of the Y. M. C. A.

Professor C. H. Robertson, scientist and lecturer, who introduced the wireless telegraph in Manchuria. Professor Robertson is shown here demonstrating the apparatus to Governor C. C. Sen

reported that fading was reduced and more than 88 percent found super-power just as easy to tune out as the regular power, ranging from 500 to 5,000 watts. Static and disturbances from electrical devices were less on the high power according to 70 percent of the reports. The southern and western auditors wrote that although 5,000 watts from WGY were inaudible, or weak, the super-power produced good signals.

Short Waves Gain in Popularity

SHORT wave broadcasting continues to gain in popularity. Station CJCM, Mont Joli, P. Q., Canada, using the slogan "On Top of the World," has stopped broadcasting on 312 meters and is now working on waves below 50 meters.

Station WTIC, Hartford, Connecticut, has installed a low-wave equipment which is recognized in the air as IXG, an experimental call. This transmitter has been heard in Australia.

Airship's Elevation Measured By Radio

ELBERT N. TODD, of Crisfield, Maryland, has patented a method of ascertaining elevations of aircraft, the principal feature of which is the transmission of a radio wave at the surface of the earth, which may be consequently detected by receiving instruments carried by the airplane.

Radio Supervisor in Sub-Treasury Building

THE United States Radio Supervisor and his staff, assigned to the New York area, are now located on the third floor of the United States Sub-Treasury Building, at Wall, Nassau and Pine Streets, having moved from Room 603 at the Customs House.

How to Improve Tone Quality

THE tone quality of the Western Electric 540-W cone type loudspeaker in connection with some sets can be improved by a simple alteration which engineers term "loading." The first operation is to remove the thumb screw at the apex of the cone. The second step is to remove the five screws nearest the centre, at the rear of the loudspeaker. This allows the metal ring to be removed and leaves the inside mechanism open to view. Then remove the three screws which hold the mechanism in position on the frame. The next step is to remove the small screw which holds the driving armature to the support at the open end of the horseshoe magnet and place a small piece of friction tape between the two metal parts the screw holds together. A small hole must be cut in the tape to permit the screw to pass through. Then wind the piston of the driving mechanism with tape and stretch it tightly, but do not bend the rod. The tape on the driving pin, which extends through the apex of the

Courtesy of the National Council of the Y. M. C. A.

Li Yuan Hung, recent president of the Republic of China, is an enthusiastic patron of the popular scientific lectures. He is shown with his son and daughter and Professor Robertson. The apparatus in the picture was built for this lecture work and was mounted on panels so as to be accessible from front and rear, allowing every detail to be followed out. Two 5-watt tubes were used for transmitting, and for reception, a detector and two stages of A. F. amplification were used, three more stages being added when the loudspeaker was employed

Courtesy of the National Council of the Y. M. C. A.

Here is a typical Chinese audience, assembled to hear Professor Robertson's lectures. Such a group meets four times each day

cone, should be vulcanized by burning it with a match. This prevents it from loosening. The operation is now completed and the loudspeaker can be reassembled.

KFKX Features Farm Service

ONE of the most complete market and weather report services in the middle west has been instituted by station KFKX, Hastings, Nebraska. The reports, radiated five times daily, are furnished over a special Government wire to the studio of KFKX, direct from the Federal Department of Agriculture. Quotations from the principal primary livestock and commodity markets in the midwest territory are broadcast. The reports are put on the air at 9:30 A.M., Central Standard Time, 10:30 A.M., 12:30 P.M., 3:00 P.M., and 7:00 P.M. This schedule applies to all week days except Saturday, when the station signs off at 12:30 P.M. KFKX's wavelength is 288.3 meters.

All Stations Placed on Equal Basis

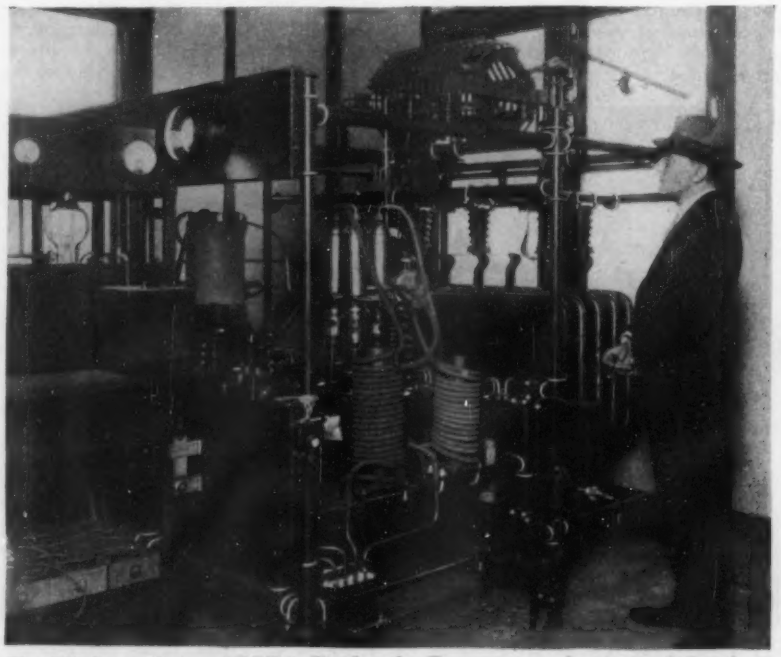
IT has been decided by the Department of Commerce to eliminate all distinction between stations, such as Class "A" or "B." Four years ago, many of the stations radiated phonograph music and some of the more progressive program directors announced that they would broadcast entertainment furnished by artists actually performing before the microphone. The latter transmitters were termed Class "B" and the others were listed in Class "A."

Secretary Hoover said, "From now on all stations will be on the same basis. There will be only one test—that is, service to the listener; and this test will be applied to every station, big or little."

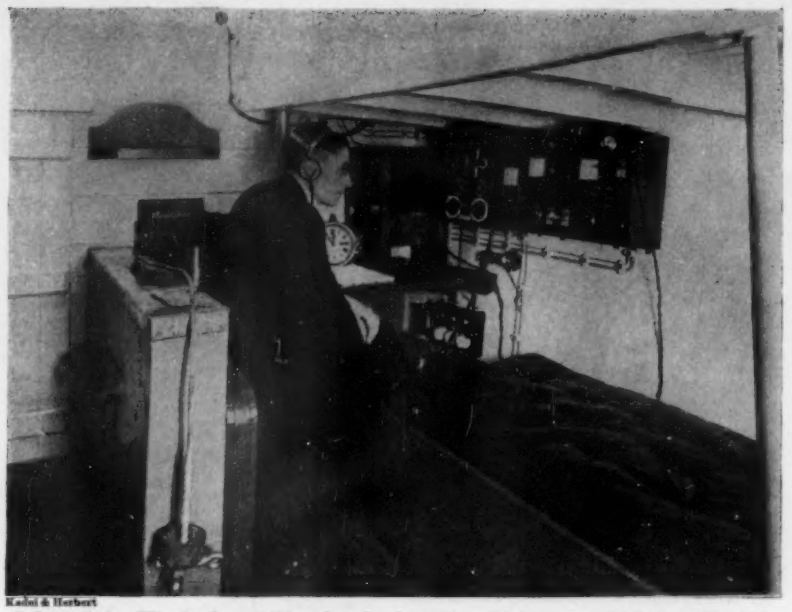
Engineers Report on Distortion

NIGHTTIME distortion associated with fading signals depends definitely upon the distance and direction of the receiving set from the broadcaster, according to a study made by engineers of the American Telephone and Telegraph Company, extending over several years, the results of which have been made public. The observations revealed that while reception in the vicinity of the transmitting station may be practically perfect, the same receiver in a more remote area would, after sunset, pick up only very mutilated signals.

The investigation brought to light the fact that even daytime signals behave in a peculiar manner. Measurements on received signals show that for a given distance from the broadcasting station, the waves were by no means of equal strength in different directions.



The 309-Meter Voice of KDKA, Pittsburgh. Two streams of water cool the plates of the four 10-kilowatt transmitting tubes. The rubber hose is wound around the cylinder to give length to the column of water and thus prevent it from conducting the high-voltage current from the plate and ruining the set. A column of water that has a small cross section in proportion to length is a poor conductor of electricity



Kadel & Herbert

Cabin of the *Elizabeth* and *Blanche*, the forty-foot lifeboat in which four English mariners will attempt a cruise of 38,000 miles. The transmitter is rated at one-quarter kilowatt. The receiver is a Marconi lifeboat type

Although daytime observations were very interesting, it was found that they did not throw much direct light upon the question of nighttime fading and quality distortion. Consequently, a test station was established a few miles outside of Stamford, Connecticut, where, for a period of about a year and a half, many graphic records of the signals were made. At night these signals were influenced by fading, and at times became so badly distorted as to be unrecognizable. One of the mysterious features of the distortion was its continuous shifting as the signals waxed and waned. Kinks appeared in the waves as if they had been battered in transit and these kinks slid about extensively.

Midget Wave Produced

EXPERIMENTERS at the University of Iowa report that they have succeeded in producing a wave one-four-hundredths the length used by some of the large broadcasters. The Iowans radiated a wave 1.3 meters long, which is a trifle over four feet.

Clock Turns Receiver On and Off

A NEW clock, resembling an ordinary alarm clock, has been designed to automatically turn a radio receiver on or off at a specified time. It is called the "Radi-o-Larm." The timepiece is easily attached to the radio set by breaking the filament circuit and connecting the two ends to terminals on the clock. One advantage is that the clock eliminates the possibility of the tubes burning all night, as it can be set to turn off the "A" battery at a certain hour.

Improved Condenser

A VARIABLE condenser, which retains the semi-circular shaped plates but affords straight line frequency tuning, has been produced by the Cardwell Manufacturing Company. This condenser secures straight line tuning by using plates whose thickness is tapered, so that as the plates are rotated, they dovetail more closely, because of the varying thickness of both stator and rotor plates.

Myers Tube Plant Now in Cleveland

THE Myers Radio Corporation will manufacture tubes in the United States. Patent difficulties compelled this concern to stop manufacturing in this country in 1922, and since that time the plant has been located in Canada. A new plant is in operation at Cleveland, Ohio. Prior to December, 1922, these tubes were made in Jersey City. Their type of construction was entirely different from the ordinary style of tube, in that the elements were small, minimizing capacity effects. The leads of the plate and positive filament were brought out of one end of the tube and the leads of the grid and negative filament out of the opposite end. Expiration of certain patents now enables the Myers Corporation to manufacture in the United States.

Radio Trade Meeting

THE fifth annual convention of the National Radio Trade Association will be held at the Hotel Ambassador, Atlantic City, the week of May 10, according to F. E. Potter, chairman of the committee on annual meetings.

May Relieve Inland Stations of SOS Watch

IT is recognized that inland broadcasting stations cannot interfere with the receipt of SOS calls from ships at sea, and therefore it has been recommended that those radio stations which, by reason of their location, power and wavelength, cannot, in the opinion of the Secretary of Commerce, cause interference with SOS calls, be relieved of maintaining a watch for the distress signals. If this recommendation is adopted, the stations will also be relieved of the requirements of having a licensed commercial operator; and a special class of license, which does not require the operator to know the code, will be substituted.

Civic Enterprise Puts St. Louis on Radio Map

CIVIC enterprise has built a 5,000-watt broadcaster for St. Louis, Missouri. Sixteen commercial concerns backed the project and the transmitter is now on the air. It is known as "The Voice of St. Louis." Its construction cost $110,000; and it is estimated that the annual cost of operation will be approximately $135,000. The transmitter is located 16 miles from the city, so that interference will be minimized.

New Loudspeaker a Departure

A NEW type of loudspeaker, called the Audalion, has been developed by Dr. Lee DeForest. It is a complete departure from the cone and horn type devices; and it is said to transmit sound on an entirely different basis—along horizontal and vertical planes instead of in concentric circles. The machine is cylindrical in shape, ten inches in diameter, eighteen inches tall and does not employ a diaphragm. A specially constructed unit actuates a membrane covering on the outside and this reproduces the sounds.

Why Blood Will Tell

Astounding Discoveries About Heredity—Dramatically Revealed

WOULD you like to know what science tells about cousin marriages, about royal families, about genius, about mixed breeds? How you came to have blue or brown eyes, why you are tall or short, fat or slender, active and athletic, or slow and phlegmatic? What science knows about the right sort of person for you to marry? What science can tell you about your future children, whether they will be healthy, strong and beautiful, or weak and generally inferior?

Albert Edward Wiggam has dedicated his life to making the truth of heredity understandable to the man in the street. In his new book, "The Fruit of the Family Tree," he has dramatized for the average man and woman the discoveries of Science regarding heredity and its relation to human progress, making the knowledge of the biological laboratory a matter of immediate personal concern. He has translated the findings of the great specialists in biology, psychology, and anthropology into plain, every-day facts, which his gift of vivid, lucid statement makes clear to those who are not specialists but who wish to keep up with this fast advancing Science.

Albert Edward Wiggam

Do You Know—

that virtue, intelligence, beauty, ability to succeed in life, capacity to make money, are all largely matters of heredity?

that insanity, epilepsy, nervous prostration, feeble-mindedness, criminal tendencies, are inherited?

that twins are the most wonderful beings in the world?

that most popular ideas about "prenatal influence" are complete nonsense?

that the intelligence of the American people is declining?

that there is only one way to stop the decline?

that science knows the mechanical means of heredity by which virtue and vice, beauty and homeliness, intelligence and stupidity, baldheadedness and color-blindness, tuberculosis and bad colds, are transmitted from parent to child?

Read Albert Edward Wiggam's "The Fruit of the Family Tree"

Here is a book of fascinating interest. A helpful book that gives new meaning to Romance. It is packed with the good news that Science brings to you for your children. It dissipates clouds of fear from the minds of people who have believed much nonsense about prenatal influences, pointing out that a new Eden lies in the future here if America will be guided by Science. It is a book for fathers and mothers, for young people, for teachers, for legislators, and for business men.

"Why should one read fiction for a pastime," says Professor Edward Ainsworth Ross of the University of Wisconsin, "when Mr. Wiggam can make the reports from the scientific laboratories so thrilling? His posing of puzzles—as in cousin marriages, twin resemblance, and inheritance of disease—and then the flashing upon the stumped reader of the solution, found by the experimenters and the observers of the last twenty years, holds the fascination of a Sherlock Holmes Story."

A Source of Inspiration

"The inspiring thing to me about all this," says Mr. Wiggam himself, "is that it gives us such an exalting view of life. It proves not that we are slaves, but that we are masters of our environment. Some idea of the richness of suggestion and enlightenment that one finds in Mr. Wiggam's book is found in such questions as these which make the reader stop and ponder as he goes from page to page:

Do you realize that education can add nothing to anybody's inborn natural mental powers; that education can wonderfully train what one is born with; it can add nothing to inborn capacity; do you know that while the Government knows officially the quality of its best hogs, mules, horses, sheep, cattle, and goats, it does not know officially the quality and ancestry of its best or worst human beings? Do you know why it is that more people go insane during times of peace than in times of war, and why it is that city people produce great men more than twice as fast as country people?

Do you know that Man-o'-War and every other great race horse in the world today have in their veins the blood of Eclipse and Hambletonian Ten, "two horses over one hundred years ago."

Mr. Wiggam's conclusions are as constructive as his questions are startling. His book abounds in illustrations of the strange and mysterious growth of famous "Family Trees." One of these is that of the Edwards Family—which includes such names as Jonathan Edwards, Aaron Burr, Mrs. Eli Whitney, Robert Treat Paine, Chief Justice Waite, Winston Churchill, Gen. Ulysses S. Grant, Mrs. Theodore Roosevelt, Dr. George E. Vincent, and Grover Cleveland.

"The Fruit of the Family Tree" has grasped the imagination and interest of thoughtful Americans as have few other books of this kind. It is historic and prophetic. Above all, it is a guide-book of sound usefulness for those who recognize the importance of getting acquainted with one's ancestors, and who wish to have their children grow up to the full limits of their inherited capacities.

Here Are the Chapter Headings:

Does blood tell?
What heredity tells, and how it tells it
What education tells
What prenatal influence tells
What twins tell about heredity
What cousin marriages tell about heredity
Is disease inherited?
Is brain power inherited?
Measuring heredity in royalty
Influence of leaders upon national life
Can we make the human race more beautiful?
Woman's place in race improvement
Can we make motherhood fashionable?
Birth control—a two-edged sword
Does heredity or environment make a man?
What you can do to improve the human race

* * * * * * * * * * *

This volume is handsomely bound in dark cloth with orange and black labels. It contains 391 pages and is fully illustrated with photographs and charts. The price is $3. Mail your coupon TODAY or send a Post Card.

THE OUTLOOK COMPANY
BOOK DIVISION
120 East 16th St., New York

You may send me my copy of Albert Edward Wiggam's "The Fruit of the Family Tree." Upon receipt of this book and bill for same I will remit $3 or return it to you within five days at your expense.

S.A.-2-26

Name .....

Address .....

City ..... State.....

Appreciation from an Aviator

From Lieutenant Cyrus Bettis, U. S. A., winner of the Pulitzer trophy in the 1925 Air Races, comes the following encouraging telegraphic message:

Editor, Scientific American:

You are to be commended for the amount of space devoted to aviation in your December issue. Editorial on commercial aviation is especially good. All publicity of this sort will certainly hasten the progress of aviation in this country.

Bettis.

Can a Stone Bend Without Breaking?

Does stone ever bend? Few of us would be likely to answer that question in the affirmative. Yet this comparatively rigid material, under favorable circumstances, does sometimes bend, as one of our readers, who has seen a bent stone, writes us.

Recently, while walking in the city of Elizabeth, New Jersey, I noticed in a cemetery a horizontal, white stone slab, supported at each corner on a stone column, and bearing a marked sag in its center. This aroused my curiosity and I went in to investigate it.

As I had my vest pocket camera along, I took a couple of snapshots. The top slab measured 6 feet long and 3 feet wide, and the thickness was about 3 inches. The material appeared to be white, fine-grain sandstone. The top slab had an inscription about a woman, concluding with the statement that she died in the year 1831. This inscription was rather faint but could readily be made out.

Three years ago as I traveled in Sweden, I saw blocks of granite of a reddish tint with darker wavy bands, as if the mass had been bent while in a pasty state of consistency. Later, I read an article by a Swedish geologist in which he pointed out that rock under great pressure and under the influence of the ever-present, rock dampness, may change shape without breaking, a relocation of the crystals taking place under those conditions.

This theory appears quite plausible, but for my part I never thought I should see a stone bend without breaking, the rare mineral "flexible stone" excepted. In the case presented here, however, it appears that stone, at least some kinds of stone, may bend under certain conditions without breaking, and in such a short space of time as less than one hundred years.

G. A. Akerlind.

Geologists tell us that many kinds of rock will bend while cold, without breaking. This will take place within a short time, if the force is great enough and the rock is confined on all sides; or it will often take place during very long time periods under slight stress. In laboratories, rocks have been made to flow while cold, taking up new shapes under extremely high pressure. Much work of this nature was done by Prof. C. R. Van Hise many years ago, and Prof. P. W. Bridgeman, of Harvard University, whose researches on many kinds of matter under extremely great pressures are noted. Man's estimate of rock as a rigid material is based on his own short life of experience. Nature works over millions of years. In exceptional cases, such as the one described by one of our readers, where the rock was thin and poorly supported, a hundred years is often sufficient.

Our Prophecy Realized

No one will begrudge us the satisfaction we enjoy in receiving a letter of this kind:

Editor, Scientific American.

Dear Sir:

In one of your editions of the Scientific American in the beginning of the year 1924, your editor predicted that a fireless cooker would be made that would reduce to a minimum the expenditure of energy, time and fuel in cooking food. That article inspired me to make experiments which resulted in getting a patent on it. I have been using it in my own home for a year and have scrapped my gas stove. It is a great satisfaction. The food is put cold in the pots, then put in the ovens, then the heat

Bent stone monument in the cemetery of St. John's Episcopal church at Elizabeth, New Jersey. The monument was built in in 1831

The Book Department

The recent discoveries and determinations with regard to the action of ATOMS and ELECTRONS of such men as Millikan and Lodge behooves one to become acquainted with a subject that undoubtedly will, in the near future, very materially affect our industrial processes, even possibly life itself.

With this in mind the following selection of books on the subject will be of assistance to our readers as a means to that end.

Atoms and Rays by Sir Oliver Lodge.....$3.15
A theoretical treatment of the subject by Great Britain's most prominent Physicist. A masterly contribution to science.

The Electron; its isolation and measurement and the determination of some of its properties—by Millikan 2.15
Millikan is to the United States what Lodge is to Great Britain. This book fully justifies his position as one of the leading Atomic theorists.

Concerning the Nature of Things by Bragg..... 3.15
The author presents in simple language a consideration of the atom, gases, liquids and solids and X-ray analysis. In his unique style he makes the profundities of science read like a tale of adventure.

Constitution of Matter by Born..... 2.65
Translated from the German. Three valuable essays which deal with their subjects from different points of view. They have been carefully brought up to date, incorporating the latest advances.

Atomic Theories by Loring..... 5.20
Gives the important theoretical and experimental investigation of the atom and its structure and the arrangement of electrons in atoms, in molecules, and in ions.

The A B C of Atoms by Russell..... 2.15
A thoroughly admirable book for the reader, who, while not familiar with technical physics, wishes nevertheless to be informed of its latest developments.

Ether and Reality by Lodge..... 2.15
A series of discourses on the many functions of the ether of space, written for the layman.

Within the Atom by Mills..... 2.15
Without mathematical formulation it deals with modern theories as to matter and energy, emphasizing the granular structure and electrical nature of matter.

All prices postpaid

Chemistry and Civilization
By A. S. Cushman

Though many books have recently appeared which seem by title to be similar, none cover the historical aspect in a more condensed, comprehensive manner than this new and revised edition. Published by E. P. Dutton & Co. $2.65 postpaid.

Aeronautical Meteorology
By W. R. Gregg
Meteorologist, U. S. Weather Bureau

Intimate knowledge of the characteristics of the atmosphere is essential to aviation, but it is also of more than passing interest to all those following sports. Written for the layman, this book may well be placed in every library. Published by The Ronald Press Co. $2.90 postpaid.

Analysis of Financial Statements
By H. G. Guthmann
Asso. Prof., Business Admin., Univ. of Texas

Explains how the facts presented in a financial statement may be easily and fully interpreted. A complete guide for somewhat advanced analysis. Published by Prentice-Hall, Inc. $5.20 postpaid.

Science, Religion and Reality

Lord Balfour has written the introduction to this collection of essays by various personages of high repute. He does not attempt to explain some of the divergent views, but grants that in all respects independent thinkers cannot be expected to coincide, by the very fact of their independence. Published by The Macmillan Co. $2.65 postpaid.

The First World Flight
By Lowell Thomas

The narrative of the individual and collective experiences of the six World Flyers as absorbed by the author in extended intimate contact with the participants. Published by Houghton, Mifflin Co. $5.20 postpaid.

Blockade Running During the Civil War
By F. B. C. Bradlee

The intimate relation between the military strategic operations, the railroads and blockade running is admirably clarified, while the fascinating old reproductions add charm as well as historical importance. Published by Essex Institute. $7.50 postpaid.

Jesuit Martyrs of North America
By J. J. Wynne

Hereto appearing in books or chapters about one or other of the principals, the author has collected and condensed into a general history the record of these pioneers of heroic stature whose work was of the very foundation of our country. Published by The Universal Knowledge Foundation. $1.65 postpaid.

How Radio Receivers Work
By W. Van B. Roberts

A complete well illustrated treatment of the many phases of radio reception, being specially valuable to constructors. Many significant points omitted in other works are fully covered. Published by Doubleday Page & Co. $1.15 postpaid.

[All the above books are obtainable from the Scientific American Book Department, 233 Broadway, N. Y. C.]

A novel home-made fireless cooker

is turned on for a little while, then turned off. The womenfolk can go shopping, visiting or to work or to church, and when they return the food will be cooked and warm enough to serve. Another satisfaction is that when the oven door is open and the heat turned on, the bottom is used for frying, broiling, toasting and heating leftovers.

Your magazine has been an education to me in many ways. I have for forty years been reading it, and it has helped me. It surely must have enlightened hundreds of thousands of others in their different ways of thinking and demonstration.

Malcolm J. McFarlane.

We Are Still from Missouri

We have received a "come-back" from Professor Miethe, the original mercury-into-gold transmutationist. He says he obtained gold from mercury only under very peculiar conditions which were probably not duplicated in the Scientific American gold tests, namely, only during interrupted burning of heavily overloaded lamps. These conditions actually were duplicated, however in the Scientific American gold test, for it was soon found that no arc with the dimensions given in Professor Miethe's reports, using 170 volts, will operate steadily at atmospheric pressure. This, therefore, disposes of the Professor's conjectural objections to the outcome of our tests. Here is what he writes:

Editor, Scientific American:

I learn from the daily papers that the scientists who have worked with you to verify my investigations on the formation of gold from mercury have obtained no positive result. These gentlemen have expressed the opinion that possibly our original mercury may have contained gold.

In a paper which will appear shortly *(Zeitschrift für Anorganische und Allgemeine Chemie)* I have already disarmed this objection, expressed from another source, by a systematic investigation, and we can assert with the greatest safety that the original mercury never contained more than 1/10,000,000 of a milligram of gold in a kilogram, or better said, never an amount that could be detected by our present and very refined analytical methods.

Although the experiments of the American scientists (who, so far as we know here, used mercury lamps) resulted negatively, this may doubtless be explained by the behavior of the mercury lamps themselves, for I have no reason to doubt the care taken in the experiment in any way. We have shown, by numerous experiments (which we have also published) that mercury lamps give gold only under very definite conditions, namely only when through the irregular burning of heavily overloaded lamps, unstable electric processes take

place in the arc; that is, when temporarily, at least, voltage and current strength are in an unstable ratio to the instantaneous arc length.

Meanwhile, as you know, we have also made other experiments since August of last year and, among others, we have constructed apparatus in which the formation of gold takes place in a ratio to the current consumption which can be expressed numerically, and therefore in which the accidental conditions in the mercury lamps can always be systematically repeated in predetermined times.

If you desire to concern yourself further in assisting to explain the formation of gold, we will gladly send you, if you so desire, my further publications on this subject as they appear. Naturally it would be best if one of your scientists would work here in our laboratory once; he would then be able to convince himself in a few days of the reality of the phenomena.

Miethe.

Spirit Photographs Again

Appreciating the fact that there are two sides to every question, we are glad to present for your consideration, a letter from Sir Arthur Conan Doyle giving his views on Dr. Prince's article in our December issue:

November 26.

Sir:

I may be doing Dr. Prince an injustice by not waiting for the printed version of his remarks, and commenting at once upon the cabled version. He will understand, however, that if I did not do so my reply might be too late for any immediate number of the Journal.

Dr. Prince makes two charges and I will take them in turn.

The first is that I "acclaimed" certain psychic photographs by two young mediums named Falconer, and said they were "marvellous" whereas they were in fact reproductions of well-known paintings.

When I first saw these photographs, some eight or nine weeks ago, I said they were marvellously artistic which is obviously true. I then examined them carefully, recognized that they were reproductions of paintings and wrote as follows under date September 20th to the Editor of the *Psychic Gazette*, the letter appearing in the October issue:

"Sir: I noticed that you used my name in connection with the spirit photographs alleged to be produced by the young Mr. Falconers. I have had no opportunity of personally testing these mediums and I cannot allow my name to be used in connection with this work. I did express the opinion that one of their results was on a higher plane of art than any which I had seen before, but this does not of course necessarily mean that it is genuine.

"There are several points which they have to meet which are not necessarily final but which are so far suspicious that they are calculated to bring suspicion and scandal upon the cause which we all have at heart. One is that the stuff which surrounds the faces is more like shredded cotton wool than any I have seen. The use of a lens makes the matter even more dubious. On the top of this the figure reproduced in your engraving 4 is unquestionably the well-known picture "Blossoms" by Albert Moore. One has a feeling also that No. 3 (this was the one which several spiritualists afterwards identified as a Murillo) is also familiar. Such cases of transference may conceivably be innocent but I repeat that they are suspicious and that it is not a form of mediumship to encourage."

I wrote a similar letter to "Light." Thus it is perfectly manifest that if there was any "exposure" it was I who made it two months before Dr. Prince ever alluded to the matter.

I will now pass to the second count. It is that I exhibited a psychic photograph by one Fallis of Chicago, and that it was a fake. The facts are that in my first lecture at New York, I exhibited forty-five photographs and only one of these did I declare that I could not guarantee. This is the one of which Dr. Prince speaks. A day or two later Dr. Prince wrote to me saying that of his personal knowledge this photograph was not genuine. I at once withdrew it and I told my audience that I had done so. At the time I thought it was very gentlemanly of Dr. Prince to make his objection in a private letter rather than in the public press. It seems that my conclusion was premature.

Your readers can now see that this whole matter is a mare's nest, which differs only from many other such nests in that the Doctor has laid two eggs in it instead of one. The incident is typical of the tactics of a certain type of researcher who instead of devoting his time to something which is positive and constructive, turns all his attention to medium-baiting or to springing charges upon those who are seriously endeavoring to elucidate these difficult questions. Reasonable criticism is to be welcomed but these tactics of pure obstruction, which are compounded of incredulity to everything psychic, and credulity to everything scandalous, are an impediment to all progress. I trust that Dr. Prince will henceforth devote his undoubted abilities to solid work, and cease to waste his own time and mine by petty personal attacks, which are below the dignity of that great inquisition in which we are both engaged.

Arthur Conan Doyle.

Ingenuity

From a correspondent, Mr. Ralph C. Taylor, came this interesting bit of news:

The human mind outwitted nature recently near Pueblo, Colorado, when a a bridge contractor constructed a 100-foot steel bridge on the bank and then pulled it into place.

Workmen on two occasions constructed the piling and falsework upon which to build the superstructure as is usually done in bridge building. On both occasions the creek became swollen with flood waters and washed out the falsework just as the steel work was started.

Workmen then built the entire bridge on the roadway. When it was completed they constructed the falsework and pulled the span into place before another flood had an opportunity to wreck the piling. Timbers were greased and the steel span pulled into place by means of a large tractor on the opposite bank pulling a large cable. Only an hour was required to install the bridge which was then bolted to the concrete abutments previously poured.

The bridge, showing how the cable pulled it from the bank to its permanent position across the creek

Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

Conducted by Milton Wright

What is Commercial Property?

HERETOFORE the Scientific American has carried a department known as "News for Inventors." That many inventors found it interesting is attested by the letters they wrote to the editors concerning it. It was of interest to many others, also, who were not inventors—manufacturers, investors, capitalists, attorneys, or those in some other line of business activity. And they were interested not only in inventions, but in patents, trademarks, commercial prints and labels, copyrights, unfair competition—all the many phases, in fact, of property rights in ideas.

Obviously, since the scope of the department had spread beyond the title, the logical thing was to change the title. Hence, the new legend, "Commercial Property News."

The term "Commercial Property" includes tangible property rights of many kinds—patents and trademarks, copyrights, prints and labels—all of which owe their existence to the institution of commerce. Such commercial properties have tremendous value and play a dominating role in our present economic system. It has been said that eighty-five percent of our national wealth is based directly or indirectly upon patents, that seventy-five percent of the trade of the country involves trademarked goods, that copyrights affect all our literature and our art and that commercial prints and labels are at the heart of the advertising hub around which the entire cycle of business revolves.

Labels for Imports

IN the case of Lewis and Conger against the United States, the Supreme Court sustains the validity of the provisions of the customs laws requiring goods imported to bear a mark indicating the country of origin.

The petitioners imported certain merchandise which the New York Collector of Customs detained in his custody, requiring the same to be marked, branded or labeled so as to indicate the country from which it was imported. The Collector's orders were complied with and the goods marked "Made in England," as provided by Section 304 (a) of the Tariff law of 1922.

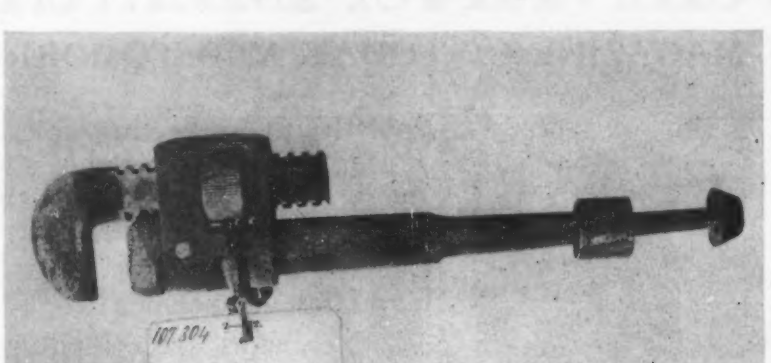
Upon liquidation of the entries the Collector assessed an additional duty of 10 percent *ad valorem* on the ground that the goods had not been properly and legally marked upon entry. The Board of General Appraisers upheld the action of the Collector and the Board's decision was affirmed by the Court of Customs Appeals. In its opinion the Supreme Court refused to review the decision of the customs court.

Fountain Pen Bargains

PEOPLE like to think they are getting bargains. You might get a little tingle, for example, at paying only two dollars for a fountain pen labeled "Morrison's No. 33 1/40-14K gold-mounted, self filling, $10."

That pleasure is going to be denied you hereafter. The Federal Trade Commission refused recently to allow the Morrison Fountain Pen Company to continue marking its pens that way, inasmuch as the company sold the pens to jobbers for one hundred and forty-four dollars a gross, and they usually retailed at two dollars, although occasionally two dollars and fifty cents and three dollars were obtained.

"The prices marked upon such pens by the respondents are false and fictitious prices far in excess of the usual retail selling prices," says the Commission, "and were placed upon such articles by the respondents with the intent and purpose of misleading and deceiving the purchasing public as to the value and the usual selling prices of such pens."



THE ORIGINAL STILLSON WRENCH

Upon this model Daniel Stillson obtained his patent in 1870. It has been dug out of the Patent Office files and transferred to the Smithsonian Institution. Note the absence of the wooden handle; it was burned off in the Patent Office fire of 1877. This invention probably has been more widely used than any other single article upon which a patent ever was obtained

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

Of General Interest

RADIO STATION INDICATOR AND FINDER.—Which can be applied to any type of set in which the dial readings are constant. Patent 1553210. E. G. Ballenger, 805 Healey Bldg., Atlanta, Ga.

PHONOGRAPH.—In which a form of horn is provided giving softer and more pleasant tones. Patent 1553633. S. J. Rognlie, Lewistown, Mont.

DRIP SHIELD FOR SHAVING BRUSHES.—Adapted to receive the excess water from the brush, and prevent it from dropping down and soiling surrounding objects. Patent 1553710. H. I. Muus, Vancouver Barracks, Washington.

FLEXIBLE NOZZLE.—For use in guiding liquids from a hose line into various receptacles, particularly tanks of automobiles. Patent 1551893. F. A. McDonald, 1538 Eleventh Ave., San Francisco, Cal.

WAFFLE IRON.—In which the two sections are each provided with a heat retaining recess, and a novel means for turning the iron. Patent 1553989. J. E. Cook, Box 671, Harrisburg, Pa.

PAINT OR PRINTERS' INK SOLVENT AND PROCESS FOR MAKING THE SAME.—Whereby ink may be diluted and when used in connection with halftones a clearer and more effective print secured. Patent 1553914. J. E. Rhodes, K. Route, Centralia, Wash.

METHOD AND APPARATUS FOR EXTRACTING GASES FROM LIQUIDS.—Whereby gases can be efficiently and quickly removed from liquids, as they are circulating through the apparatus. Patent 1554138. V. V. Sobennikoff, c/o Prosvesc Neneye, 9 Second Ave., New York, N. Y.

PIPE.—Having a stem with tortuous passage, effectively cooling the smoke, and preventing nicotine from being drawn into the smokers' mouth. Patent 1554537. A. F. Teigen, "A" St. South, Moorehead, Minn.

POSTURE BOOKREST.—Designed for use on desks, tables and other supports, for holding a book in open and upright position. Patent 1554979. J. A. Dugan, Decd., Mary R. Dugan, Executrix, 51 Clark St., Brooklyn, N. Y.

ARTICLE OF FURNITURE.—In the form of a novel web assemblage, of ample strength to sustain the springs of sofas or chairs for an indefinite period. Patent 1554902. K. Balikjian, 95 Clinton Ave., Newark, N. J.

DEVICE FOR TREATING SOIL.—Around plants, by means of a "mulch paper" containing a fertilizer which will be gradually released as the paper disintegrates. Patent 1554865. E. H. Magoon, P. O. Box 2929, Honolulu, Territory of Hawaii.

SMOKEHOUSE.—Provided with an arrangement of rotary frames, onto which racks for supporting the articles to be smoked, may be revolved during smoking. Patent 1554,906. L. Brand, c/o M. Brand & Sons, First Ave. and 49th St., New York, N. Y.

PROCESS OF TREATING ORES.—At the mines, by the simple agents of water and fuel without regard for the usual transportation facilities. Patent 1554917. G. Kunkle, Grand Junction, Colo.

CONCEALED COMPARTMENT FOR SAFES.—In which bills of large denomination, jewelry and other very valuable articles may be supported and concealed against casual search. Patent 1554900. B. Baer, Oakland Ave. and Trysting Place, Cedarhurst, L. I., N. Y.

MEMORY AID.—Which consists of a conveniently printed list of articles, which may be checked, and the checks erased after use. Patent 1554480. J. S. Anderson, 20 N. Halsted St., Chicago, Ill.

FOUNTAIN TOOTHBRUSH.—Wherein the brush head is connected to a handle with means for ejecting the cleansing material. Patent 1555064. G. A. La Mothe, 759 E. 138th St., New York, N. Y.

FLUSH TANK.—The valve lifting means of which is located at the end, so as not to interfere with the seat. Patent 1555620. J. G. Ayers and G. D. Barnes, Dayton, Tenn.

BRACING STRUCTURE FOR FOLDING BEDS.—Which affords facilities for positively pre-

Patent Troubles in China

AN internationally known firm of patent attorneys receives the following report from its agents in Shanghai:

"It has come to our attention that quite a number of Chinese are obtaining patents under the provisional regulations, and as the Ministry of Commerce do not make any examination in order to ascertain if applications or letters patent contravene or infringe upon foreign patents, a number of patents are probably issued on inventions or improvements which will, in fact, infringe patent rights of foreigners. While China has not, at the present time, a patent law for the granting of letters patent to foreigners, yet protection for foreign patents may be claimed under the treaties with China. For this purpose, the Consulates of the foreign nationals concerned, as well as the Chinese Maritime Customs in Shanghai, accept for filing purposes only, applications for the registration of foreign patents.

"The Chinese Government is considering the drafting of a patent law which will be for the benefit of foreigners as well as Chinese. It will, therefore, be apparent that obtaining an official date of filing with the Customs and with the Consulate at this time on patents' specifications will, later on, prove of considerable importance in claiming priority of invention in China."

The point of the report is: If you have an invention which you think may be of importance in the future in China, apply now for the provisional patent registration at present in force there.

Mark Twain, Inventor

ALL of us are familiar with Mark Twain's work as a writer, some of us know of his career as a publisher, but how many of us know of him as a successful inventor? It is a fact that for a considerable period of time he derived a steady income from royalties on one of his three patents.

He called it "Mark Twain's Self-pasting Scrapbook." The patent was granted to him June 24, 1873, according to P. J. Federico, writing in the *Journal of the Patent Office Society*. Twain realized the importance of being able to prove priority of invention, so, nearly a year before applying for a patent, he wrote to his brother Orion a letter printed in Albert Bigelow Paine's biography of Mark Twain:

> "But what I wish to put on record now," the humorist wrote, "is my new invention—hence this note, which you will preserve. It is this—a self-pasting scrapbook—good enough if some juggling tailor does not come along and ante-date me a couple of months, as in the case of the elastic vest-strap.
>
> "The nuisance of keeping a scrapbook is: 1. One never has paste or gum tragacanth handy; 2. Mucilage won't stick, or stay, four weeks; 3. Mucilage sucks out the ink and makes the scraps unreadable; 4. To daub and paste three or four pages of scraps is tedious, slow, nasty and tiresome. My idea is this: Make the scrapbook with leaves, veneered or coated with gum-stickum of some kind; wet the page with sponge, brush, rag or tongue and dab on your scraps like postage stamps. Lay the gum in columns of stripes."

The book enjoyed a steady sale for years in its original form and later in an improved form. During the first royalty period twenty-five thousand copies were sold.

Chemical Patents

THE Chemical Foundation, Inc., of 85 Beaver Street, New York City, has published a list of patents owned by it and available for license to all American manufacturers.

venting collapse of the frame at the meeting ends when the frame is extended. Patent 1555168. J. M. Thomas, R. No. 3, Box 192 R, Tampa, Fla.

LOOSE LEAF BINDER.—Having means for holding the bottom and top binder parts in spaced relation for permitting the removal or insertion of leaves. Patent 1554416. F. H. Crump, 225 E. 4th St., Los Angeles, Calif.

APPARATUS FOR FACILITATING WINDOW CLEANING.—Readily applied to a window irrespective of its dimensions, in such manner that the sashes may be swung inwardly. Patent 1554488. H. E. Binkele, 901 N. Spring St., Los Angeles, Cal.

CABLE TIGHTENER.—Whereby slack in a cable may be readily taken up and the requisite tension held. Patent 1555351. A. Boynton, c/o Frontier Oil Co., City National Bank Bldg., San Antonio, Texas.

BELT BUCKLE.—Having interengaged parts at all times retained in true relation, yet readily disengaged for opening. Patent 1555,764. R. Slote, c/o Messrs. Slote & Schaffer, 49 E. 21st St., New York, N. Y.

HIGH-PRESSURE STILL.—For refining naphtha, gasoline and other petroleum products, which not only heats the liquid to be distilled but caused a thorough circulation. Patent 1555761. W. F. Schanzlin, 1809 Lakewood Ave., Lima, Ohio.

ADJUSTABLE BROOM.—In which the head supporting the bristles may be increased or decreased in accordance with the use in which it is employed. Patent 1555630. R. R. Brock, 806 Quincy St., Brooklyn, N. Y.

DISPENSING CONTAINER.—From which a predetermined quantity of the contents may be removed, without discharging the remainder. Patent 1555591. J. L. Larrison, Wharton, N. J.

FLEXIBLE GAFF.—Especially adapted for landing fish after they have been hooked, means being provided for illuminating the gaff for night use. Patent 1555748. H. M. Lutz, 26 S. Maryland Ave., Atlantic City, N. J.

ANIMAL TRAP.—Intended to strangle the caught animal, by a loop or snare encircling the throat when the bait trigger is actuated. Patent 1555133. J. H. McLean, c/o Matt Wagner, Clark, Wyoming.

VALVE.—So constructed that after a predetermined volume of water has been discharged, the valve will automatically close. Patent 1555755. W. A. Pratt, 1130 Ave. C, Bayonne, N. J.

WINDOW SEAL STRIP.—Which will close the opening between the sashes when one sash is raised, preventing the passage of flies and the like. Patent 1556461. F. Thill, c/o Saunders, Young & Grann, 144 N. E. Second St., Miami, Fla.

COUPON.—Whereby an organization can stimulate the attendance of the public on their own store, and direct attention to other merchants. Patent 1556515. H. E. French, c/o Massachusetts Adv. & Sales Service, Inc., R. 409, 220 Devonshire St., Boston, Mass.

FURNITURE ELEMENT FOR SHOE FITTING.—Comprising a foot-rest board for use in connection with a foot-length measure as used in shoe stores. Patent 1556521. D. F. Hart, 177 W. 79th St., New York, N. Y.

GEM MOUNTING.—For use in clasps for connecting the ends of necklaces, bracelets and similar articles of jewelry. Patent 1556465. F. B. Wendel, c/o Hercules Novelty Mfg. Co., 126 South St., Newark, N. J.

SAFETY CHEST.—The contents of which are protected by a lock, and also an alarm structure, which will operate for a long time. Patent 1556519. G. O. Gumbs, 17 No. Park Ave., Rockville Centre, N. Y.

FLUSHING TANK.—Especially designed for successful operation in places where the water pressure is low. Patent 1556100. N. J. Gondolf, 703 State St., New Orleans, Louisiana.

HOLDER FOR MINIATURE LOUDSPEAKER.—Adapted to hold the speaker in such a position that the bell portion simulates the lips of a figure. Patent 1556010. I. H. Fishelov, 5010 N. Troy St., Chicago, Ill.

SPOUT CAN.—With an improved spout for pouring out the oil, and an attached means for perforating the can to cause an even flow. Patent 1555383. H. Ramslie, Delano, Calif.

ROLL FOR PRINTING PRESSES AND METHOD OF MAKING SAME.—Characterized by an elastic facing which inherently yields to the type and freely assumes a normal smooth state. Patent 1555389. G. M. Stevens, 938 Harrison St., San Francisco, Calif.

EXERCISING DEVICE.—For use in exercising the hyoglossus muscles of the tongue to improve and develop the vocal organ. Patent 1556493. W. Conway, Box 768, Jacksonville, Fla.

EGG BEATER.—Adapted for beating eggs, cream, etc., in closed jars and adjustable for jars of different depths. Patent 1557364. A. R. Headley, Mulberry, Ohio.

BOUQUET STAY.—Particularly adapted for supporting bouquets of flowers as used in floral designs for funeral purposes. Patent 1557506. R. L. Walthers, Tomahawk, Wis.

HEEL FOR BOOTS AND SHOES.—Of rubber construction, the worn parts of which may be readily removed and replaced. Patent 1557448. W. Felstead, 1653 Ferwood Rd., Victoria, B. C., Canada.

DEVICE FOR MAKING WIRE BANDS FROM WHICH WHALEBONES ARE MADE.—Formed of resilient metallic wires embedded in a convenient coating which unites and protects the same for use in corsets. Patent 1557365. A. Josse, c/o Office Picard, 97 Rue St. Lazare, Paris, France.

SENSITIZED ELEMENT AND MOUNTING THEREFOR.—Which when used in mounting photographic enlargements, or like subjects, will retain the same in such manner as to present a smooth surface. Patent 1557346. F. Schwanhausser, c/o Rusling Wood, 218 William St., New York, N. Y.

BUBBLE PIPE.—Whereby a plurality of bubbles may be blown at one time, and a fair supply of soapsuds retained within the pipe. Patent 1557421. I. E. Cohn, 65 Fourth Ave., New York, N. Y.

GAS VALVE.—Which will automatically close to shut off the supply when the temperature reaches a point sufficient to melt a fusible connection. Patent 1557313. J. H. Lindsay, 1117 Jefferson Ave., Brooklyn, N. Y.

BROOM.—In which a threaded attaching member is embedded in the head, by which accidental withdrawal of the head is prevented. Patent 1556841. C. M. Keener, c/o W. H. Zachry, Atlanta Variety Works, St. Charles, Lakeview & Greenwood Aves., Atlanta, Ga.

FUEL BRIQUETTE AND PROCESS OF MAKING THE SAME.—Comprising a fifty percent mixture of fine anthracite and semi-bituminous dust coal, subjected to 1,000 degrees, Fahrenheit, for a short time. Patent 1557,320. J. F. O'Donnell, Morris Run, Pa.

FASTENER.—Easily manipulated for the purpose of holding papers together in a file or binder. Patent 1557996. G. H. Ennis, 64 Jesup Place, Bronx, N. Y.

RESILIENT GRIP.—Of cohesive and elastic tape, adapted to be wound around the handles of tools and the gripping members of sporting articles. Patent 1556781. T. E. Gjorup, 3454 Pierce Ave., Chicago, Ill.

ANTIFREEZING PUMP.—Having means for permitting the water in the pipe to flow back into the well, and become a prime for the next pumping operation. Patent 1557,949. M. Walton, Ullin, Ill.

Hardware and Tools

FISHING TOOL.—Especially adapted for use in straightening and subsequently removing objects from oil or other wells. Patent 1556692. E. B. Karn and L. J. Leuthart, Buffalo, Mont.

LOCK WASHER.—Whereby a nut may be held against accidental turning or loosening when applied to a bolt. Patent 1558736. J. A. McCoy, c/o Sparks & Walters, Redding, Calif.

DOLLY-HAMMER CYLINDER FRONT HEAD.—Particularly designed for use in connection with a "Model 8 Waugh" drill sharpener. Patent 1559338. M. McHale, Anyox, B. C., Canada.

Machines and Mechanical Devices

BRICK OR BLOCK CUTTER.—Which minimizes the breakage of the wires and springs used in machines for cutting bricks from solid bars of clay. Patent 1555769. A. P. Steele, Statesville, N. C.

WAVE MOTOR.—Taking advantage of the vertical variations of the surface of the waves, and adapts itself to the rise and fall of tides. Patent 1555682. S. H. McKnight, 9 Bentley Ave., Jersey City, N. J.

WINDMILL.—In which certain of the blades of each sail will receive the wind pressure for more than a half circle. Patent 1555776. W. R. Twiford, Box 1, 141 North East 1st St., Miami, Fla.

ATTACHMENT FOR PAPER JOGGERS.—For use with conventional joggers, and including elements for properly guiding the sheets into the jogger as they come from the press. Patent 1554590. W. A. McGarvin, c/o Dunne Bros., 200 New High St., Los Angeles, Calif.

WINDMILL.—Wherein the mechanism for transmitting motion from the wind wheel is of such character as to transmit a smooth and powerful movement. Patent 1556276. J. H. Wilson, Mitchell, Neb.

COIN DETECTOR.—For coin operating machines, which functions to automatically weigh and measure the coins so that substitutes are cast aside. Patent 1556477. W. C. Bellows, 2465 Broadway, New York, N. Y.

TURBINE WHEEL.—Whereby blades can be easily attached to the periphery to form a series of buckets to receive impelling fluid. Patent 1556532. P. J. Maher, 157 E. 18th St., New York, N. Y.

WINDMILL.—In which a plurality of windmills are cooperatively connected for driving motors for use in irrigating farm land. Patent 1556715. W. M. Riggs, c/o The Riggs Bank, Willcox, Ariz.

LIFTING ATTACHMENT FOR RIVETING MACHINES.—For lifting power operated machines over obstructions, in a horizontal plane, for example, the side of a girder. Patent 1556693. D. Kennedy, 2106 W. Cary St., Richmond, Va.

MACHINE FOR AUTOMATICALLY APPLYING COVERS ON BOXES OR SIMILAR PACKINGS.—Particularly pasteboard boxes or similar packings. Patent 1557500. P. Nordenfelt and E. Frisk, Ostermalmsgaten 44, Stockholm, Sweden.

MOTION-PICTURE PROJECTING MACHINE.—With mechanism whereby great lengths of film are saved in the projection of the titles. Patent 1557334. P. Roble, c/o Joaquin Montoya, 143 W. 82d St., New York, N. Y.

APPARATUS FOR SEPARATING UNBURNED COKE FROM THE PRODUCTS OF COMBUSTION.—The coke being separated from the cinders or clinkers by immersing them in water. Patent 1556672. C. I. Boyer, Box 87, Ridgway, Pa.

SPACING TABLE FOR METAL SHEET-PUNCHING MACHINE.—By means of which a metal sheet may be automatically advanced a predetermined distance after each punching operation. Patent 1557438. J. A. and J. A., Jr., Dowd, Fall River, Mass.

TIDE MOTOR.—Including a pair of spaced walls, barges mounted for vertical movement between said walls, and motors carried by the barges. Patent 1557787. F. D. Taylor, 911 Pontiac Ave., Elmwood Station, Cranston, R. I.

PILE CUTTER.—Which will automatically cut the piles of pile fabric, either in segregated rows or entirely across a piece of fabric. Patent 1557345. J. Schumacher, c/o Schumarzenbock Huber Co., Bergenline Ave. and Oak St., W. Hoboken, N. J.

SHIELDED HOIST CONTROLLER.—In which the switch, the governor, and the gears are entirely encased to preclude the accumulation of dust and the like thereon. Patent 1556858. H. H. Logan, c/o Duro Metal Products Co., 2649 N. Kildare Ave., Chicago, Ill.

Prime Movers and Their Accessories

PISTON CONSTRUCTION.—So constructed as to permit the replacement of the rings by removing that portion of the piston upon which the rings are disposed. Patent 1553,548. E. W. Nagel and H. G. Zehner, 607 S. Solomon St., New Orleans, La.

CARBURETOR.—Provided with accurate means for regulating the flow of air past the fuel nozzle at all speeds of the motor. Patent 1555489. A. H. and E. F. Spencer, Aurora, Neb.

TANK AND OUTLET CONSTRUCTION.—Adapted for controlling and feeding liquid fuel to an internal combustion engine, by means of a main and auxiliary chamber. Patent 1555657. G. C. Glenn, 201 So. Wilmington St., Raleigh, N. C.

DUPLEX CARBURETOR.—Having a double lead-in with a valve structure for automatically shutting off one lead-in when the other is turned on. Patent 1556526. C. G. Krebs, 133 Coffey St., Brooklyn, N. Y.

SPARK PLUG.—With a removable insulator core whereby the same may be readily disassembled to facilitate the cleaning of the point. Patent 1556251. H. Sampson, 2318 N. E. 2d Ave., Miami, Fla.

Pertaining to Recreation

PUTTING GREEN AND SIMILAR PLAYING SURFACE.—Of an artificial nature, formed from crushed cotton seed hulls, for use on golf courses where it is difficult to maintain the regular grass greens owing to arid conditions. Patent 1559520. T. McC. Fairbairn, A. S. Valdepino and R. McCart, c/o Robert McCart, 221 Mills Bldg., El Paso, Texas.

GAME APPARATUS.—Which will provide entertainment and amusement to the players without causing any appreciable mental strain. Patent 1558690. E. P. McCollom, Box 263, Baltimore, Md.

HANDBALL BAT.—Or striking device adapted to be worn on the hand of a player, either right or left. Patent 1558666. J. Brewer and H. S. Wilks, 1442 Vyse Ave., Bronx, N Y.

TOY.—Whereby a part of the toy is caused to move rapidly and a sound thereby produced. Patent 1559422. F. J. Hanley, 71 East End Ave., New York, N. Y.

Pertaining to Vehicles

GASOLINE-RESERVE DEVICE.—Which may be locked in closed position, to prevent the removal of any gasoline without the proper key. Patent 1554814. R. Glazner, Seguin, Texas.

DUST GUARD FOR SHOCK ABSORBERS.—By means of which the presence of dust and other extraneous substances in the working parts is entirely excluded. Patent 1557314. H. H. Logan, c/o Duro Metal Products Co., 2649 N. Kildare Ave., Chicago, Ill.

RIM FOR VEHICLE TIRES.—In which the retaining ring is constructed of two parts arranged to be drawn toward the center by means of bolts. Patent 1558212. C. F. Wolf, 2528 N. Drake Ave., Chicago, Ill.

SHOCK ABSORBER.—Which may be used efficiently with vehicles equipped with balloon tires, the drum being constructed in the form of an eccentric. Patent 1557463. N. F. McNaught, c/o Duro Metal Products Co., 2649 N. Kildare Ave., Chicago, Ill.

END GATE FOR WAGONS.—So constructed as to make the capacity of the wagon body greater than when ordinary gates are employed. Patent 1558292. W. H. Russell, Clarksville, Va.

HEADLIGHT.—Adapted to receive a part of the light emanating from the regular headlight, and reflect the same laterally. Patent 1556159. N. H. Rice, 229 E. Victoria St., Santa Barbara, Calif.

GOVERNOR.—Adapted to control the speed of the engine of a tractor, forming with the usual fan, a unitary structure. Patent 1559125. O. T. Nichol, 2116 No. 16th St., Omaha, Neb.

COMBINED PRESSURE GAUGE AND VALVE CAP.—Which may be readily secured to the valve of a tire to indicate the pressure of air within when manually actuated. Patent 1558660. J. E. Wood, c/o W. Lee Provol, Loyal Order of Moose, 155 N. Clark St., Chicago, Ill.

CUT-OUT FOR TRACTORS.—Which will drown the ignition system and stop the engine, when the forward end is elevated or the wheels blocked. Patent 1558775. H. P. Barras, c/o Dr. P. A. Le Bourgeois, Jeanerette, La.

Designs

DESIGN FOR A PRINTED FABRIC.—The inventor has been granted three patents, 68316, 68317, 68318. J. Lader, c/o Atlas & Bluhm, 5 White St., New York, N. Y.

DESIGN FOR A SHOE.—Patent 68431. T. Davis, c/o Franklin Simon & Co., 38th St. and Fifth Ave., New York, N. Y.

DESIGN FOR A PRINTED FABRIC.—Patent 68506. L. Bluhm, c/o Phoenix Mfg. Co., 40 Thomas St., New York, N. Y.

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